SOUTH DAKOTA

FISHERIES

STATEWIDE FISHERIES SURVEYS, 2006
SURVEYS OF PUBLIC WATERS
Part 1 Lakes Region I

South Dakota
Department of
Game, Fish and Parks
Wildlife Division
Joe Foss Building
Pierre, South Dakota 57501-3182

Progress Report
No. 07-11

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STATEWIDE FISHERIES SURVEY, 2006

Survey of Public Waters

by
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INTRODUCTION

Data gathered from May through October 2006 in State Management Region 1 are contained in this report. The Missouri River System and other State Management Regions are contained in separate reports.

OBJECTIVE

To survey waters where data is not sufficient to complete management plans or where optimum sport fishing yields are not realized under existing management and additional information is needed for plan update and remedial action.

PROCEDURE

Individual waters are surveyed to accumulate and update physical, chemical and biological data. A review of existing information accompanied new data collections. Information collected was recorded in a narrative type form developed for the South Dakota Fisheries Investigations Manual.

FINDINGS

The findings are contained in the following lake survey reports. This reporting method will allow for orderly collecting and recording data, making it available for completing and updating management plans, and evaluating current management practices.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Belle Fourche Reservoir (Orman Dam) County: Butte
Legal description: T 9N, R 3E Sec. 1, 2, 3, 7, 11-14, 19, 23-26, 29
Location from nearest town: 9 miles east of Belle Fourche, SD
Dates of present survey: July 12-13, 31; August 1-2, 2006
Date last surveyed: August 3-4, 27, 2005
Most recent lake management plan: F21-R-36 Date: 2004
Management classification: Warmwater permanent
Contour mapped: 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Yellow perch
2. Channel catfish	2. Smallmouth bass
3. Gizzard shad	3. White bass
4. Black crappie	4. Longnose sucker
5.	5. Spottail shiner
6.	6. Common carp
7.	7. Tiger muskie

PHYSICAL CHARACTERISTICS

Surface Area: 8,063 acres; Watershed: 2,867,200 acres
Maximum depth: 55 feet; Mean depth: 25 feet
Lake elevation at survey: approximately 33% of capacity

1. Describe ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation (BOR) and the Belle Fourche Irrigation District performs the operation and maintenance of Orman Dam. The South Dakota Department of Game, Fish and Parks, Division of Wildlife manages 164 acres of land below the dam grade and the Division of Parks manages 350 acres around the boat ramp (T9N R3E, Sec. 24, 25). The U.S. BOR also manages 6,617 acres around the reservoir as wildlife habitat and for public access although irrigation has priority for water rights.

2. Describe watershed condition and percentages of land use:

The Orman Dam watershed is approximately 4,480 square miles consisting mostly of private land used for livestock grazing.

3. Describe aquatic vegetative condition:

Orman had very low water during this survey with little vegetation being found in the lake.

4. Describe pollution problems:

Departmental personnel identified no pollution problems during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All structures appear to be in excellent condition. Repairs were performed on the outlets to reduce the amount of seepage from the reservoir. The Parks division put in an excellent low water ramp, which is normally needed after August 1st.

CHEMICAL DATA

1. Describe general water quality characteristics.

No water chemistry was done in 2006.

BIOLOGICAL DATA

Methods

Electrofishing

Age-0 gizzard shad were collected using a Smith-Root electrofishing boat during the day on July 31, 2006. Ten-five minute runs were made around the lake. During each run, as many age-0 shad were netted as possible and counted.

Netting

A fisheries survey was conducted at Belle Fourche Reservoir on July 12-13 for frame nets and August 1-2 for the gill nets. Gill net sampling consisted of 4 net nights (Appendix C). All gill nets were monofilament experimental 150 foot nets. The switch from 300 foot gill nets was made to get better confidence in our catch rate data. The gill net was a monofilament experimental net 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in) Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Data Analysis

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on

length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Age-0 Fish Survey

Ten sites around the lake were boat electrofished during daylight hours on July 31 to index gizzard shad reproduction. All ten sites produced shad indicating excellent reproduction through the summer (Table 1). A total of 3,112 shad were captured in 50 minutes of electrofishing. This gave a CPUE of 3,734 young of year shad per hour.

Table 1. Results for daytime electrofishing catch of age-0 gizzard shad from the Belle Fourche Reservoir, July 31, 2006.

Site	No./Site	Time (sec)	No./hr
#1 Lower-1	600	300	7,200
#1 Lower-2	235	300	2,820
#1 Lower-3	95	300	1,140
#2 Lower-1	751	300	9,012
#2 Lower-2	410	300	4,920
#2 Lower-3	217	300	2,604
Middle-1	220	300	2,640
Middle-2	147	300	1,764
Middle-3	245	300	2,940
Upper-1	192	300	2,304
Total	**3,112**	**3,000**	**3,734**

Fish Community Survey

Twelve different species were sampled between the gears during the 2006 survey. Eight species totaling 212 fish were collected in gill nets during the 2006 lake survey of Belle Fourche Reservoir. Walleye dominated the catch, comprising 51.9% of the total. Channel catfish were the second most common at 25.5% and gizzard shad were the third most abundant species with 9.0%. Other species collected were common carp, freshwater drum, river carpsucker, white bass and yellow perch (Table 2). Frame nets sampled eleven different species for a total of 119 fish. River carpsucker was the most abundant species sampled with 34.5% of the total catch. Walleye were second most abundant at 29.4% with catfish third at 17.6.

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock length (Wr>S; 90% CI's in parentheses) for all fish species collected from four, 150-ft experimental sinking gill nets in Orman Reservoir, August 1-2, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Channel catfish	54	13.5 (2.5)	13.5 (2.5)	17 (9)	4 (4)	79.4 (0.7)
Common carp	12	3.0 (1.8)	3.0 (1.8)	100 (--)	0 (--)	81.4 (1.5)
Freshwater drum	1	0.3 (0.4)	0.0 (--)	--	--	--
Gizzard shad	19	4.8 (2.4)	0.8 (0.4)	--	--	94.3 (13.8)
River carpsucker	8	2.0 (2.2)	2.0 (2.2)	--	--	87.4 (2.4)
Walleye	110	27.5 (15.7)	25.3 (14.9)	45 (9)	0 (--)	81.5 (0.2)
White bass	2	0.5 (0.8)	0.0 (--)	--	--	--
Yellow perch	6	1.5 (1.1)	1.5 (1.1)	83 (33)	17 (33)	87.6 (3.7)
Totals	212					

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Belle Fourche Reservoir, Butte County, July 12-13, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Channel Catfish	21	2.6 (1.1)	2.1 (1.0)	35 (21)	6 (10)	82.1 (4.0)
Common Carp	5	0.6 (0.5)	0.6 (0.5)	--	--	91.5 (19.2)
Gizzard Shad	1	0.1 (0.2)	0.1 (0.2)	--	--	--
Hatchery Rainbow	1	0.1 (0.2)	---	--	--	--
River Carpsucker	41	5.1 (2.5)	5.1 (2.5)	100 (--)	98 (5)	86.1 (0.8)
Rudd	4	0.5 (0.5)	---	--	--	--
Shorthead Redhorse	3	0.4 (0.4)	0.4 (0.4)	--	--	--
Smallmouth Bass	5	0.6 (0.5)	0.6 (0.5)	--	--	96.7 (8.4)
Walleye	35	4.4 (1.2)	3.0 (0.9)	75 (15)	21 (15)	71.7 (2.1)
White Bass	2	0.3 (0.2)	0.3 (0.2)	--	--	--
White Sucker	1	0.1 (0.2)	0.1 (0.2)	--	--	--
Totals	119					

Channel Catfish

Channel catfish were the second most abundant species in the gill net sample with a CPUE of 13.5, a decrease from 15.0 last year (Table 4). This is actually an increase in abundance since 150 foot gill nets were used. PSD increased from 7 last year to 17 this year. Fish condition was low with a mean Wr for stock length and larger catfish of 79.4, which is down from 88.4 last year. Length frequency shows most catfish are between stock and quality length.

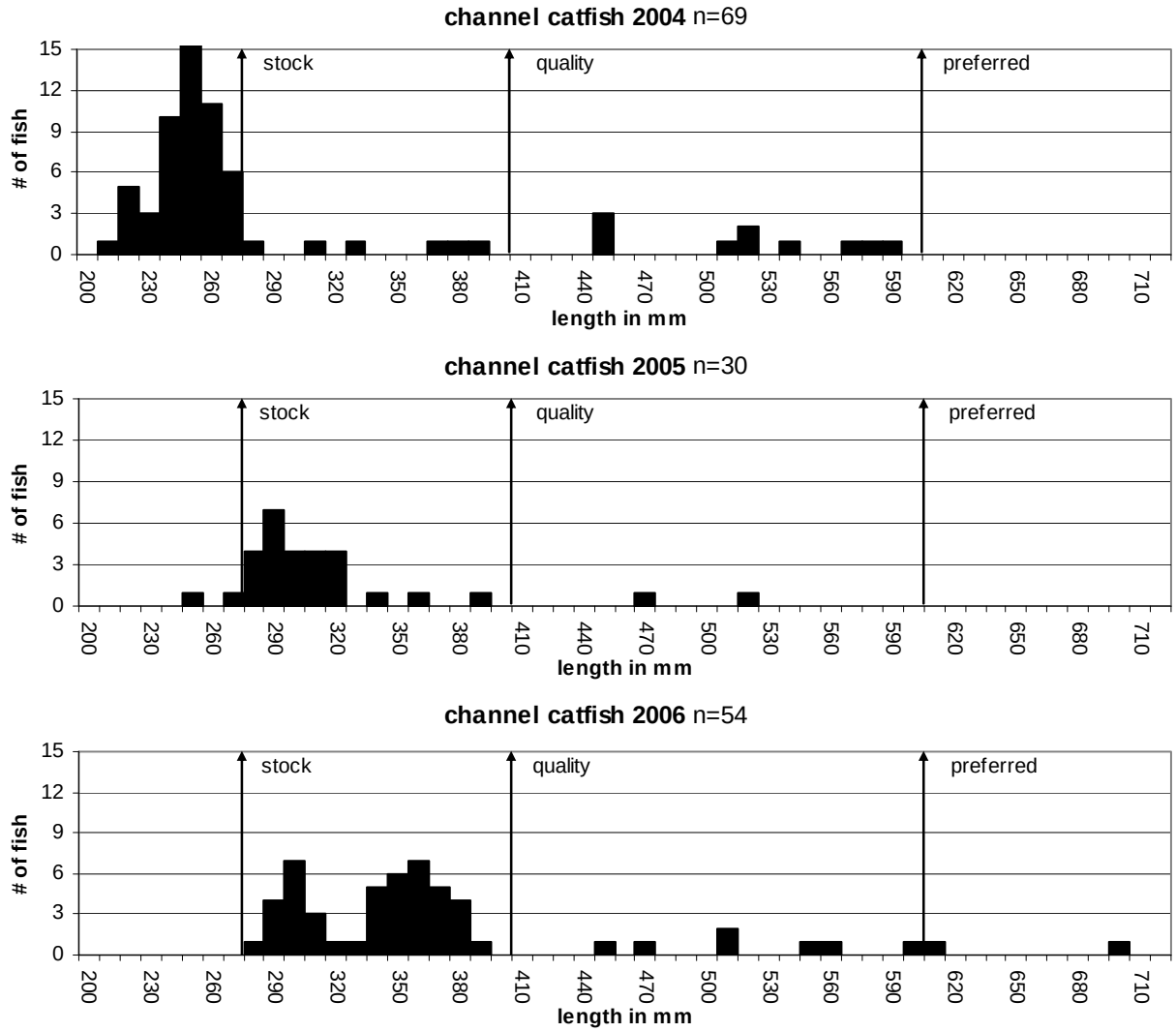


Figure 1. Length histogram of channel catfish collected in gillnets from Belle Fourche Reservoir, Butte County 2004-2006.

Table 4. Composite listing of sample size (N), catch per gillnet night (CPUE; 80% CI's in parentheses), and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for channel catfish from Belle Fourche Reservoir, 1999-2006.

Year	N	CPUE	PSD	RSD-P	Wr>S
1999	34	5.7 (2.0)	78 (12)	0 (na)	--
2000	54	13.5 (9.9)	69 (12)	2 (4)	90.6 (1.9)
2001	107	26.8 (10.3)	56 (8)	3 (3)	85.6 (0.8)
2002	45	22.5 (41.6)	51 (2)	2 (4)	82.5 (1.4)
2003	22	11.0 (12.3)	46 (26)	8 (13)	82.1 (4.5)
2004	69	34.5 (44.6)	63 (22)	0 (-)	83.5 (3.6)
2005	30	15.0 (46.2)	7 (9)	0 (-)	88.4 (3.3)
2006*	54	13.5 (2.5)	17 (9)	4 (4)	79.4 (0.7)

*150 foot gillnets instead of 300 footers pre-2006.

Gizzard Shad

Gizzard shad are thought to be the driving force behind the thriving walleye population and since their reintroduction in 1997, walleye growth rates have improved dramatically. Adult shad stocking has been done annually to ensure adequate reproduction (i.e. forage) in case of a total winterkill. Due to a mild winter and high numbers of adult shad in the previous survey, no adult shad were stocked in 2006. In spite of not stocking adults in 2006, daytime electrofishing yielded an average CPUE of 3,734 young of year shad per hour, compared to 916 last year. CPUE was 560 young of year shad per hour in 2004.

Walleye

Walleye abundance decreased. During 2006, sampling was changed from 300 foot gill nets to 150 foot nets. CPUE was 27.5 in the shorter nets.. For comparison, last year's 300 foot gill net CPUE was 125.5 (Table 5). Very high confidence levels the past few years in CPUE data, makes comparing abundance difficult. Hopefully, the switch to 150 foot nets will tighten up our data's reliability.

Forty five percent of the walleye over stock length (10 inches) were also over 15 inches, which is the highest recorded since 2001. This may be an early influence of the slot regulation implemented in January of 2005 which protects fish over 15 inches and under 18 inches. Figure 2 shows a length frequency that includes frame net and gill net catch. It shows that the frame net sampled larger fish. Fish condition was average at Belle Fourche with a mean Wr for stock length and larger fish of 81.5. Growth was slightly below the state average, but good for the region (Table 6). Our current management objective for walleye size structure is a PSD between 30 and 60 and a RSD-P of at least 10. Our PSD number is right on the money but RSD-P is still lacking, this should change as protected fish start to grow to the 20-inch mark.

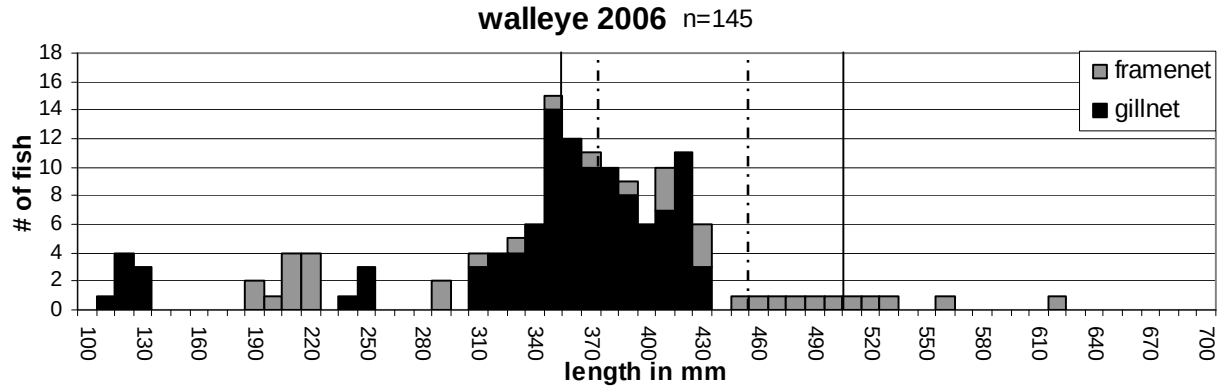


Figure 2. Length frequency histogram for gill net and frame net walleye from Orman Reservoir in 2006. The dotted line represents the 15" to 18" slot to be put in effect in 2005. The solid line represents 14" and 20".

Table 5. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for walleye collected by gill net in Belle Fourche Reservoir, 1998-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
1998	87	9.6	---	2	0	--
1999	133	22.2	---	21 (6)	0	--
2000	109	27.3 (17.6)	22.3 (11.1)	65 (9)	0 (na)	84.0 (0.4)
2001	283	70.8 (33.2)	63.8 (31.3)	47 (5)	4 (2)	86.1 (0.2)
2002	178	89.0 (40.0)	87.5 (41.6)	38 (6)	3 (2)	84.7 (0.5)
2003	317	158.5 (297.0)	125.0 (255.5)	29 (5)	1 (1)	85.6 (0.1)
2004	227	113.5 (207.8)	95.0 (153.9)	27 (5)	1 (1)	85.3 (0.6)
2005	251	125.5 (185.2)	125.5 (185.2)	40 (5)	0 (na)	76.1 (0.2)
2006*	110	27.5 (15.7)	25.3 (14.9)	45 (9)	0 (--)	81.5 (0.2)

*150 foot gillnets instead of 300 footers pre-2006.

Table 6. Belle Fourche Reservoir walleye year class, age in 2006, sample size (N), mean back-calculated total length-at-age, population standard error (SE), the Region 1 and South Dakota walleye mean length-at-ages (Willis et al. 2001).

Year			Age				
Class	Age	N	1	2	3	4	5
2005	1	4	155				
2004	2	11	158	289			
2003	3	26	168	262	331		
2002	4	28	158	277	333	372	
2001	5	34	168	267	340	376	398
Mean (SE)		**103**	**161(3)**	**274(6)**	**335(3)**	**374(2)**	**398(0)**
Region 1 Mean			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)
Statewide Mean			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)

Table 7. Mean condition (Wr) for gillnet walleye by length categories at Belle Fourche Reservoir 2001-2006.

Description	2001	2002	2003	2004	2005	2006
Substock	95.5 (1.0)	82.5 (1.2)	84.6 (2.8)	92.4 (0.4)	na	88.3 (--)
Stock to quality	88.0 (0.4)	87.3 (0.2)	87.3 (0.1)	87.2 (0.5)	78.5(0.3)	83.6 (0.4)
Quality to preferred	84.5 (0.2)	80.4 (0.4)	81.8 (0.1)	80.9 (0.6)	72.5(0.5)	78.9 (0.3)

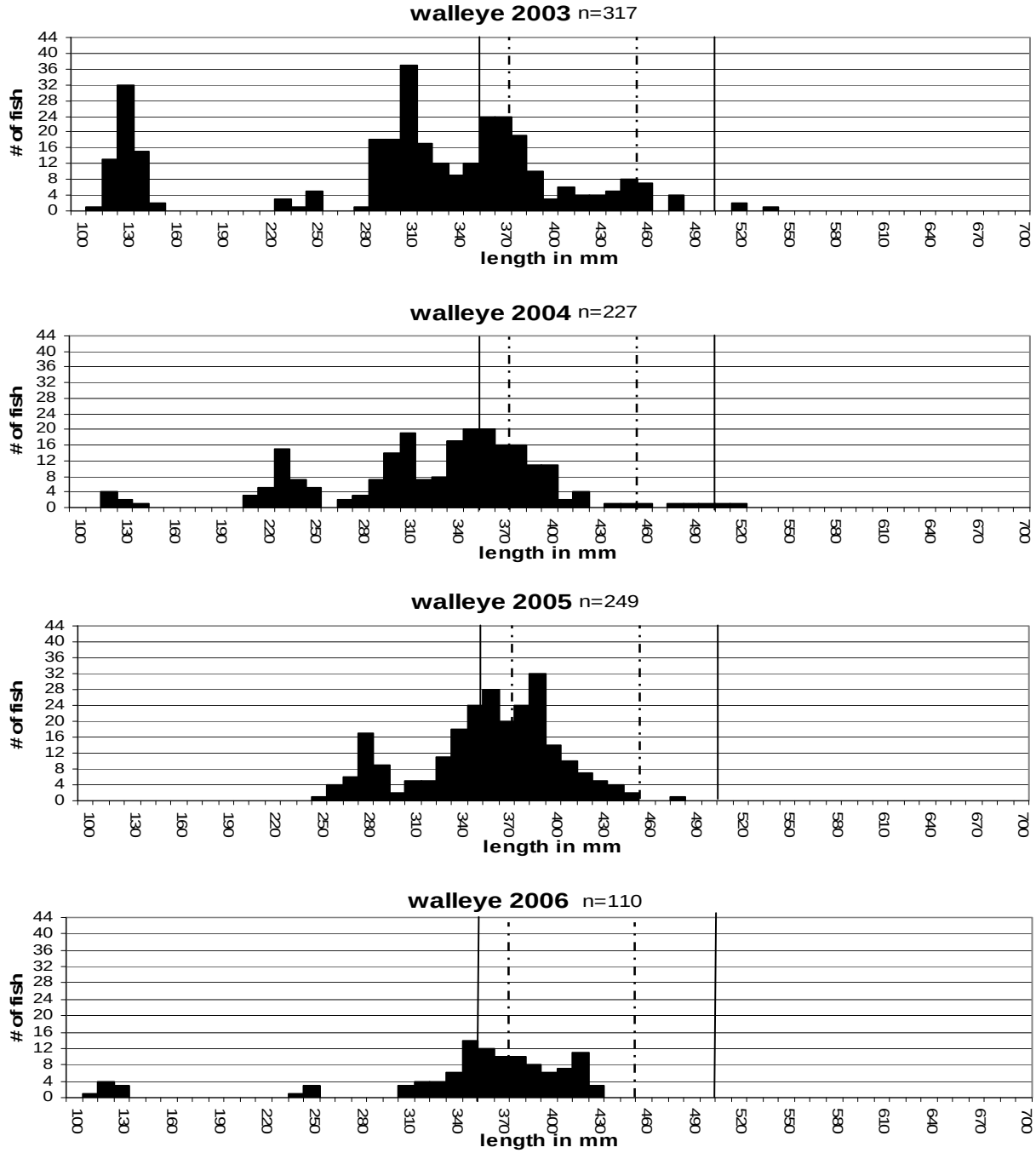


Figure 3. Length frequency histogram for gill net walleye from Orman Reservoir 2002-2006. The dotted line represents the 15" to 18" slot to be put in effect in 2005. The solid line represents 14" and 20".

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting lake surveys annually to evaluate fish populations and monitor new regulation effects.

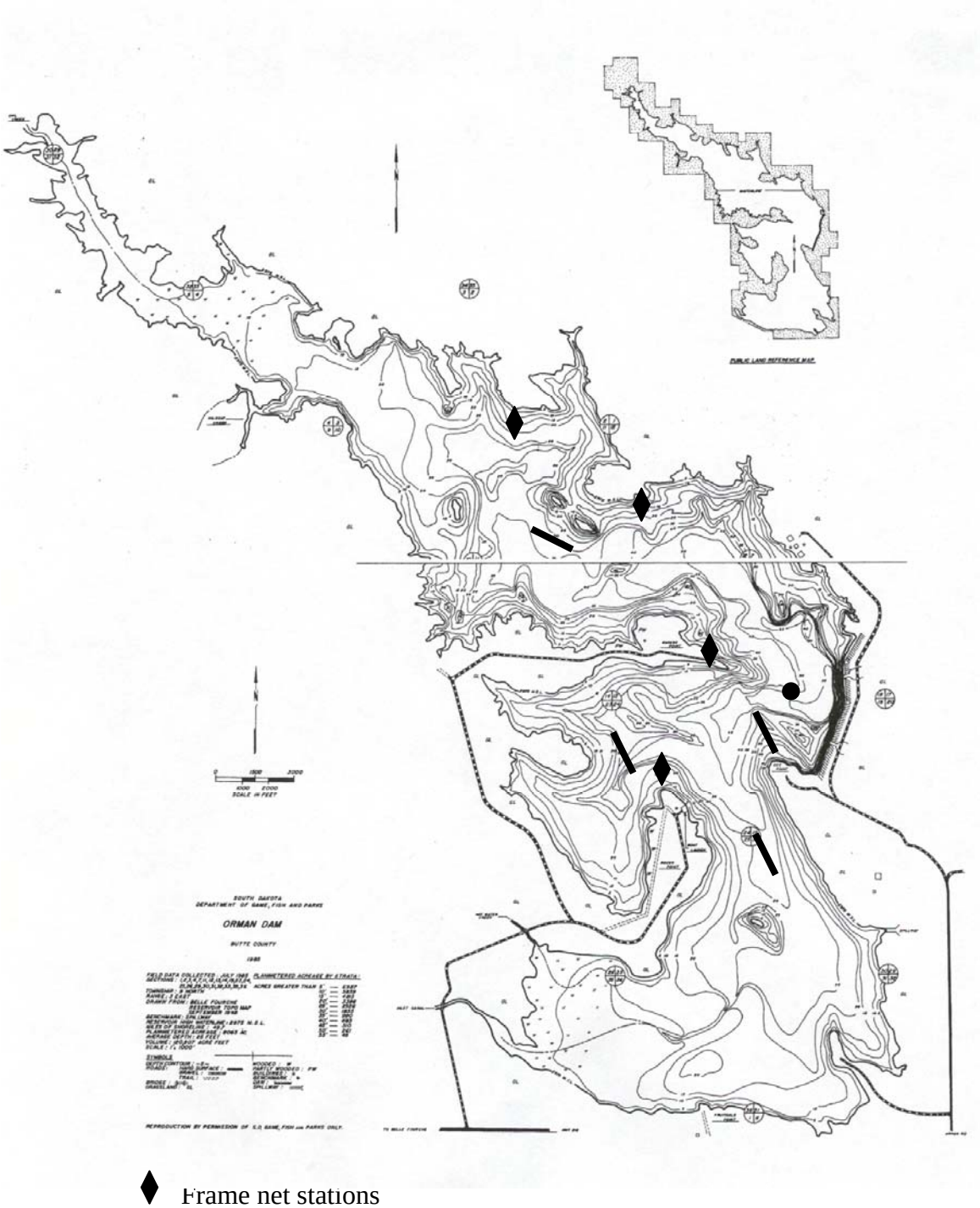
2. Stock with adult gizzard shad annually to ensure forage base for walleye as over winter survival of shad is questionable.

3. Place Christmas trees in lake this spring to provide yellow perch spawning habitat, which could help provide forage for walleye before the shad young of year become available.

APPENDICES

Appendix A. Stocking record for Belle Fourche Reservoir Reservoir, Butte County, 1996-2006.

Year	Number	Species	Size
1996	7,414	Rainbow trout	Fingerling
	25,000	Tiger muskie	Fingerling
1997	95	Gizzard shad	Adult
	1,969	Rainbow trout	Catchable
	239,503	Walleye	Fingerling
1998	516	Gizzard shad	Adult
	22,819	Rainbow trout (S)	Fingerling
	37,130	Tiger muskie	Fingerling
	250,000	Walleye	Fingerling
1999	522	Gizzard shad	Adult
	640	Muskellunge	Large fingerling
	2,000	Tiger muskie	Large fingerling
2000	493	Gizzard shad	Adult
	14,867	Rainbow trout (C)	Fingerling
	39,162	Rainbow trout (M)	Fingerling
	40,000	Rainbow trout (S)	Fingerling
	2,600	Tiger muskie	Large fingerling
2001	48	Gizzard shad	Adult
	1,900	Tiger muskie	Large fingerling
2002	2,000	Tiger muskie	Large fingerling
	23	Gizzard shad	Adult
2003	171,893	Walleye	Fingerling
	18,436	Rainbow trout	Fingerling
	1,500	Tiger muskie	Large fingerling
	102	Gizzard shad	Adult
2004	1,605	Tiger muskie	Large fingerling
	120	Gizzard shad	Adult
2005	182	Gizzard shad	Adult



Frame net stations

Water chemistry

Gill net location

Appendix B. Locations of sampling site on the Belle Fourche Reservoir, Butte County, 2006.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Newell Lake County: Butte
Legal description: T 10N, R 6E Sec. 9
Location from nearest town: 8 miles north and 2 miles east of Newell, SD
Dates of present survey: May 30-June 1, 2006; October 27, 2006
Date last surveyed: June 15-17; October 26, 2004
Most recent lake management plan: F21-R-36 Date: 1997
Management classification: Warm-water permanent
Contour mapped: 1991

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Smallmouth bass
2. Bluegill	2. Rudd
3. Northern pike	3. White sucker
4. Yellow perch	4. Black bullhead
5. Walleye	5.

PHYSICAL CHARACTERISTICS

Surface Area: 183 acres, 74 ha; Watershed: 7680 acres
Maximum depth: 32 feet; Mean depth: 13.6 feet
Lake elevation at survey (from known benchmark): -3 feet

1. Describe ownership of lake and adjacent lakeshore property:

The Department of Game, Fish and Parks own Newell Lake, as well as the surrounding property. The shoreline is managed as a recreation area and a game production area.

2. Describe watershed condition and percentages of land use:

The Newell Lake watershed is approximately 12 square miles of pasture land, most of which is over grazed.

3. Describe aquatic vegetative condition:

Submerged aquatic vegetation in Newell Lake consists of coontail and cattail. Summer months are often characterized as having large amounts of vegetation in the shallow bays and inlets. Emergent vegetation consists of bulrush and cattail.

4. Describe pollution problems:

No pollution problems were identified during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

In 1998, following the lake survey, major damage occurred to the tubes that required rebuilding the spillway. Work on the spillway was completed in 1999. The spillway and dam is currently in good condition. At the time of the survey, low water made the boat ramp barely useable.

CHEMICAL DATA

1.Describe general water quality characteristics.

Water chemistry was done on August 1, 2006 by the DENR.

2. Thermocline: No

3. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted at Newell May 30 – June 1 2006. Sampling consisted of 2 gill net nights and 8 trap net nights (Appendix C). All gill nets were monofilament experimental nets. Each net was 45.7 m (150 ft) long and 1.8 m (6 ft) deep with six 7.6 m (25 ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at four stations consisting of 2 trap net nights each. All trap nets were modified fyke-nets with a 1.3 X 1.5 m frame, 19.1 mm (0.75 in) mesh and a 1.2 X 23 m (3.9 X 75.5 ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Newell on October 27, 2006. Electrofishing was conducted using a Smith-Root control unit with pulsed-DC. Six 10-minute sampling runs were completed during the survey. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for largemouth bass for age and growth analysis. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the Smith-Root control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Fish Community Surveys

Overall, 8 fish species were collected during the lake survey conducted May 30- June 1, 2006 (Tables 1 and 2). Only twelve fish were collected by the gill nets, with white sucker being the most abundant. A total of 348 fish were collected in frame nets, with European rudd comprising 49.7%, and bluegill comprising 40.2% of the sample. Fall electrofishing on October 27, 2006 yielded 36 largemouth bass, 1 smallmouth bass and 29 walleye. Population parameters of dominant game and forage species in Newell Lake are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock-length; 80%CI's) for all fish species collected from eight ¾ inch trapnets in Newell Lake, Butte County, May 30-June 1, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Black bullhead	2	0.3 (0.2)	0.3 (0.2)	--	--	122.0 (35.5)
Bluegill	140	17.5 (8.3)	17.5 (8.3)	57 (7)	11 (5)	102.2 (0.6)
Northern pike	1	0.1 (0.2)	0.1 (0.2)	--	--	76.7 (--)
European rudd	173	21.6 (11.9)	---	--	--	--
Smallmouth bass	1	0.1 (0.2)	0.1 (0.2)	--	--	88.6 (--)
Walleye	3	0.4 (0.4)	0.3 (0.4)	--	--	88.1 (8.0)
White sucker	23	2.9 (1.6)	2.9 (1.6)	100 (--)	100 (--)	95.9 (2.9)
Yellow perch	5	0.6 (0.6)	0.5 (0.5)	--	--	91.4 (5.2)
Total	348					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock-length; 80%CI's) for all fish collected from two 150-ft experimental sinking gill nets in Newell lake, May 30-June 1, 2006 .

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Northern pike	3	1.5 (1.5)	1.5 (1.5)	--	--	78.2 (7.8)
Walleye	1	0.5 (1.5)	0.5 (1.5)	--	--	81.0 (--)
White sucker	6	3.0 (6.2)	3.0 (6.2)	100 (--)	83 (33)	103.9 (8.6)
Yellow perch	2	1.0 (3.1)	1.0 (3.1)	--	--	92.0 (14.5)
Total	12					

Table 3. Total catch (N), fish per hour (CPUE; 80% CI's in parentheses), fish per hour of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass and walleye collected from minutes of electrofishing at Newell, Butte County, October 27, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Largemouth bass	36	35.5 (16.0)	30.8 (13.8)	42 (--)	16 (--)	114.3 (2.2)
Smallmouth bass	1	0.8 (1.1)	0.8 (1.1)	--	--	--
Walleye	29	26.8 (5.7)	24.8 (5.5)	33 (16)	4 (6)	87.9 (0.9)
Total	66					

Bluegill

Bluegill were the most abundant panfish in Newell with a frame net CPUE of 17.5 (Table 4). Stock indices yielded a PSD of 57 with an RSD-P of 11. These numbers fit right in the current management objective for bluegill with PSD between 50 and 80 and RSD-P between 10 and 30. In 2004, CPUE was 33.0 with a PSD of 76 and an RSD-P of 4. Fish condition was excellent with a mean Wr for stock-length and larger fish of 102.2, that's up from 105.3 in 2004. Bluegill growth was slower than the state mean but fish up to 8 years old were sampled (Table5).

Table 4 . Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for bluegill collected by trap nets in Newell Lake, 2002, 2004, 2006.

Year	N	CPUE-S	PSD	RSD-P	Wr>Stock
2002	192	24.0 (9.7)	76 (5)	16 (5)	92.1 (1.0)
2004	231	33.0 (8.8)	76 (5)	4 (2)	105.3 (0.9)
2006	140	17.5 (8.3)	57 (7)	11 (5)	102.2 (0.6)

Table 5. Newell bluegill year class, age in 2006, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota bluegill mean length-at-age (Willis et al. 2001).

Year			Age							
Class	**Age**	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
2002	4	27	38	57	79	98				
2001	5	37	32	49	70	91	122			
2000	6	24	33	64	90	115	139	161		
1999	7	31	35	62	101	127	151	173	188	
1998	8	21	30	57	92	123	148	168	181	192
Sample Size		140								
2004 Mean (SE)			**34 (1)**	**58 (3)**	**86 (5)**	**111 (7)**	**140 (7)**	**168 (3)**	**185 (4)**	**192 (0)**
South Dakota Mean			52	101	141	164	181			

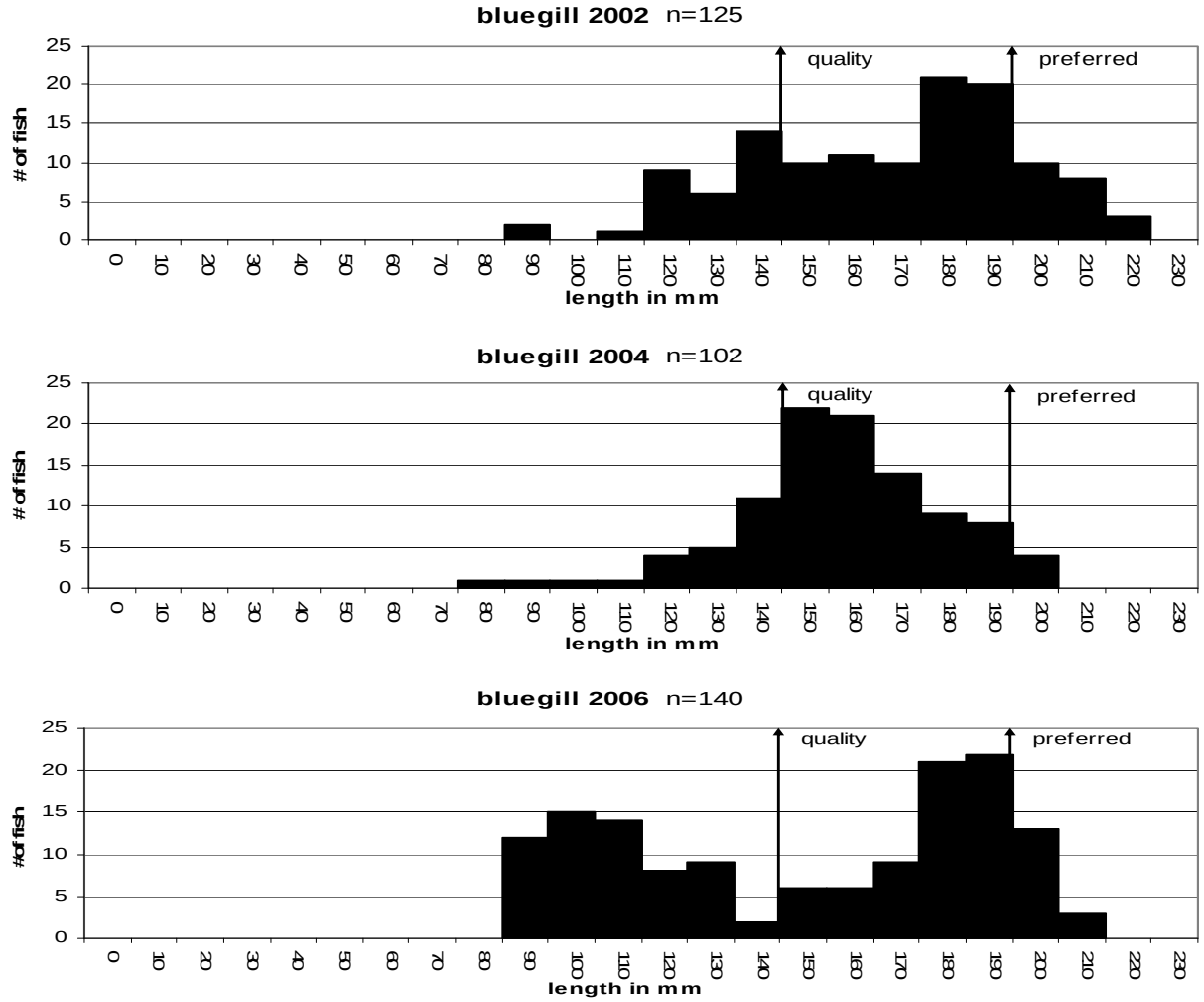


Figure 1. Length frequency histogram of bluegill collected by frame nets in Newell Lake 2002, 2004, 2006.

European Rudd

Newell's European rudd CPUE increased sharply from a CPUE of 4.0 in 2004 to 21.6 during this survey, which is close to the 2002 survey value (18.0). Size structure of the rudd population remains relatively the same as observed in during past surveys (Figure 2). Either recruitment is being limited or our gear is adapted to catch fish in the 12 to 15 inch range since fish sampled all appear to be larger fish. It may be that these are spawning fish and only the adult fish are captured in our gear. Hopefully, increased management efforts on predator densities will keep rudd densities in check.

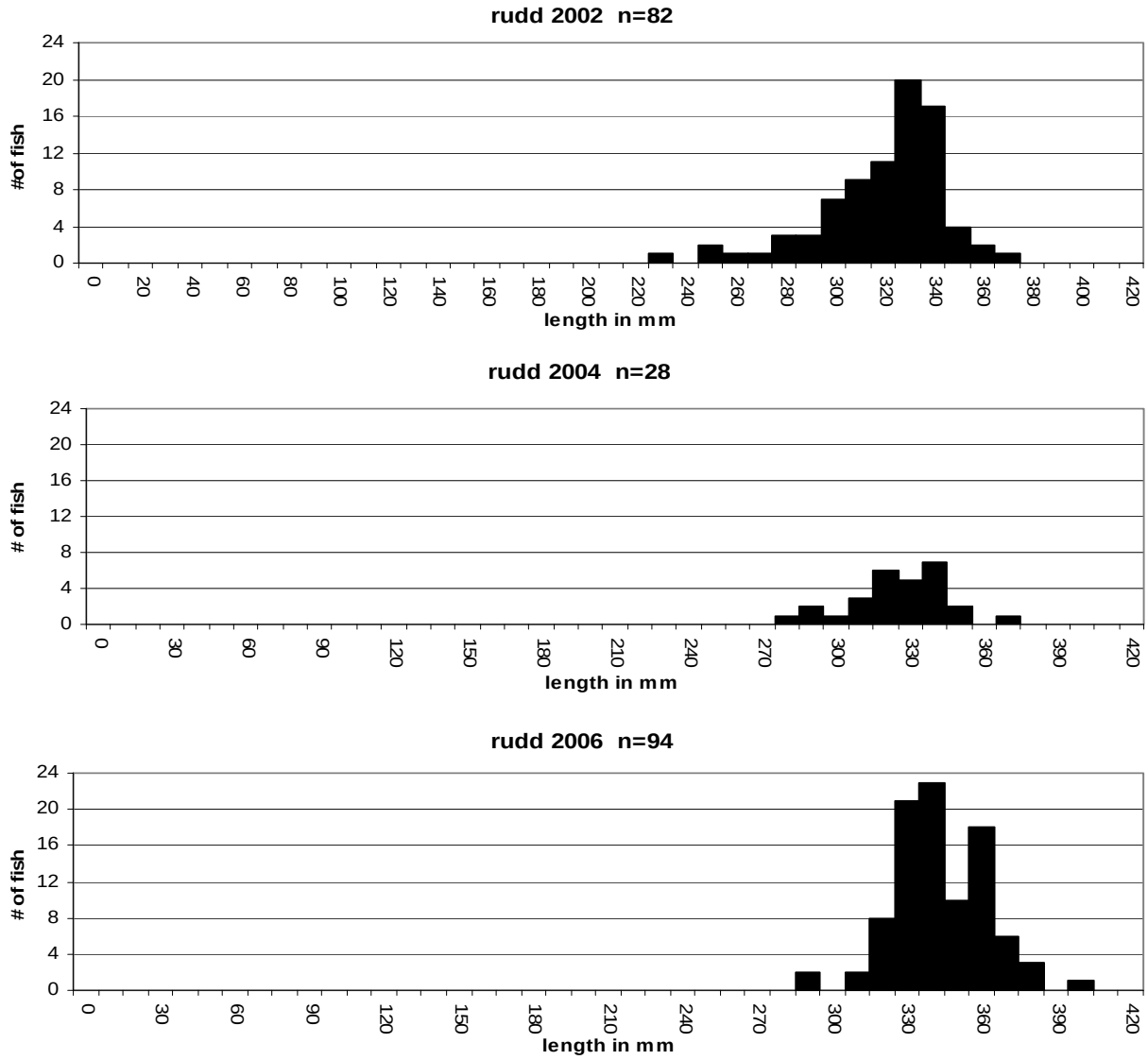


Figure 2. Length frequency histogram of rudd collected by frame nets in Newell Dam 2002, 2004, 2006.

Largemouth Bass

A 12 to 16 inch slot with a one over 16 inch regulation was put in place for 2004 to increase the numbers of larger bass. The 2005 electrofishing sample had a CPUE for stock-length and larger fish of 18.0 bass per hour, down substantially from 28.0 in 2004, but catch rates rebounded this survey with a CPUE of 30.8. In 2006, stock indices showed a slight increase, but the small sample size made confidence levels wide. PSD was 36 and RSD-P was 18, compared to a PSD of 32 and RSD-P of 0 in 2005. Fish condition remained excellent with a Wr for stock-length and larger fish of 114.3. In addition, growth was good with the average largemouth bass surpassing the state average at age-4 (Table 7). The 2006 numbers are close to the current bass management objective of a minimum CPUE for fish greater than stock length of 20 with a PSD between 40 and 70 and a RSD-P greater than 20.

Table 6. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in Newell Lake, 1999-2006.

Year	N	Pedal Time (seconds)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
1999	29	-----	14.5	9.0	67 (15)	27 (14)	--
2000	3	4,116	2.6	2.6	--	--	--
2002	125	7,200	82.2 (28)	19.2 (7)	50 (16)	0 (--)	114.6 (1.3)
2003	77	3,600	77.0 (23)	41.0 (14)	27 (12)	15 (10)	106.7 (1.3)
2004	31	3,600	31.0 (13.4)	28.0 (12.0)	36 (16)	18 (13)	108.1 (1.6)
2005	23	3,894	21.7 (9.1)	18.0 (6.0)	32 (19)	0 (--)	101.2 (1.4)
2006	36	3,800	35.5 (16.0)	30.8 (13.8)	42 (--)	16 (--)	114.3 (2.2)

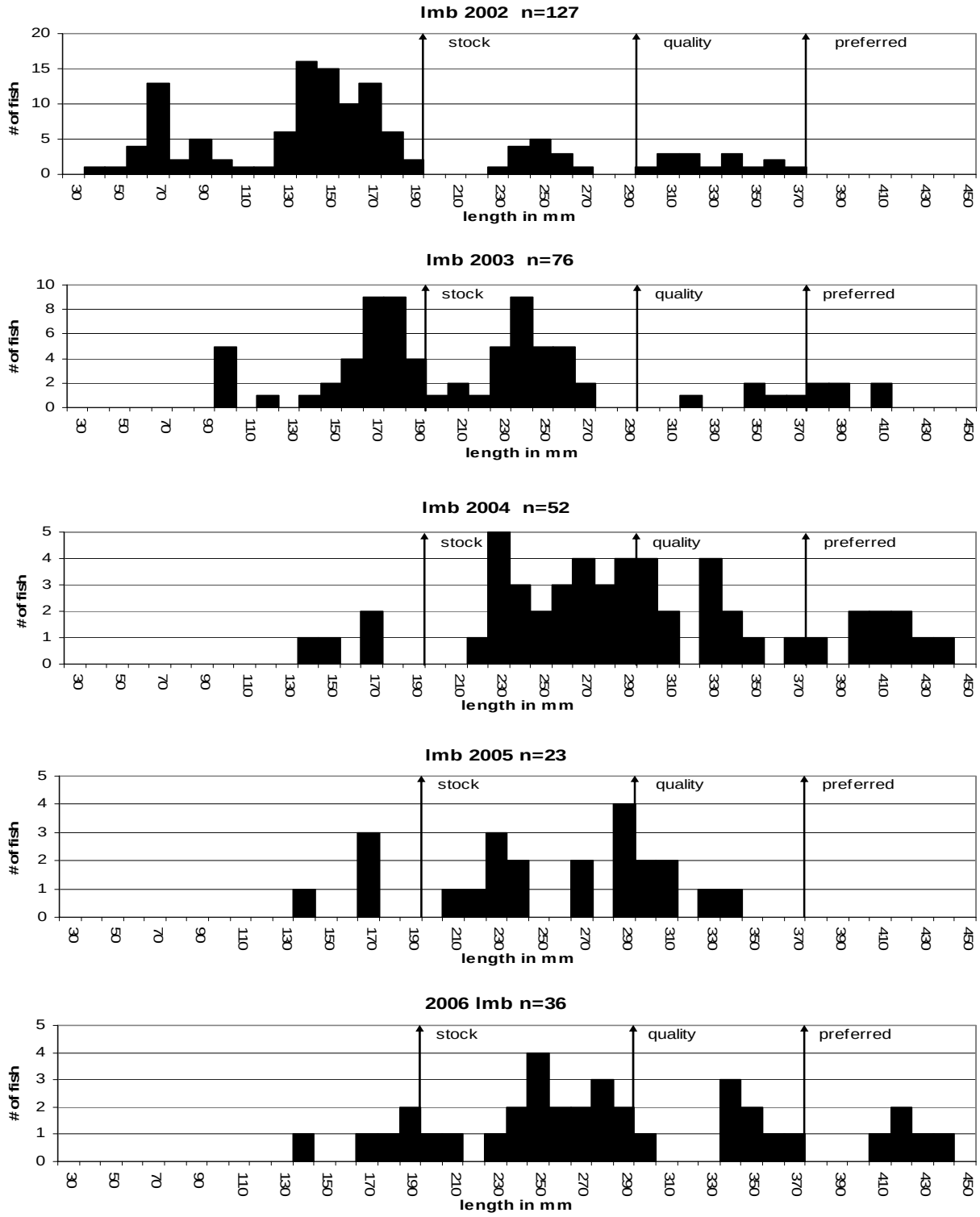


Figure 3. Length frequencies of largemouth bass collected by electrofishing in Newell Lake, Butte County, 2002-2006.

Walleye

In the fall of 2003, 1,120 advanced walleye fingerlings were stocked in attempt to increase walleye density (Appendix A). In addition, a 14-inch minimum was also placed on Newell Lake walleye starting January 1, 2004. It is hoped the increased predator abundance will provide additional predation on bluegill and rudd populations, as well as, provide a bonus walleye fishery. Gillnet CPUE was 0.5, a slight decrease from 6.0 in the 2004 survey. Current management objectives are to maintain a minimum gill-net CPUE for stock-length of 10, a PSD range of 30-60, an RSD-P of 10 or greater, and a growth rate of 35.5cm at age-3.

Since fall electrofishing is done annually at Newell Lake to sample largemouth and smallmouth bass, the walleye population will also be monitored at this same. During this year's electrofishing survey 29 walleyes were sampled, only two of which were under stock-length (Table 3). Mean fish condition was 87.9 during the fall electrofishing (Tables 3). Electrofishing numbers have been giving a better sample size than the gill nets, future management objectives may want to use electrofishing indices as a more reliable picture of the walleye population (Tables 8 & 9).

Table 8. Composite listing of catch-per-unit-effort (CPUE with 80% CI's), for walleye collected by gill nets, frame nets and fall electrofishing in Newell Lake, 2002 - 2006.

Year	Gill net	Frame net	Fall electrofishing
2002	2.0 (3.1)	1.1 (0.6)	------
2004	6.0 (9.2)	0.1 (0.2)	11.0 (5.3)
2005	------	------	16.4 (7.5)
2006	0.5 (1.5)	0.4 (0.4)	26.8 (5.7)

Table 9. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for walleye collected by electrofishing in Newell Lake, 2004-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr>Stock
2004	11	11.0 (5.3)	10.0 (5.9)	80 (24)	0 (--)	84.7 (2.2)
2005	16	16.4 (7.5)	14.7 (8.1)	19 (17)	6 (11)	78.9 (1.6)
2006	29	26.8 (5.7)	24.8 (5.5)	33 (16)	4 (6)	87.9 (0.9)

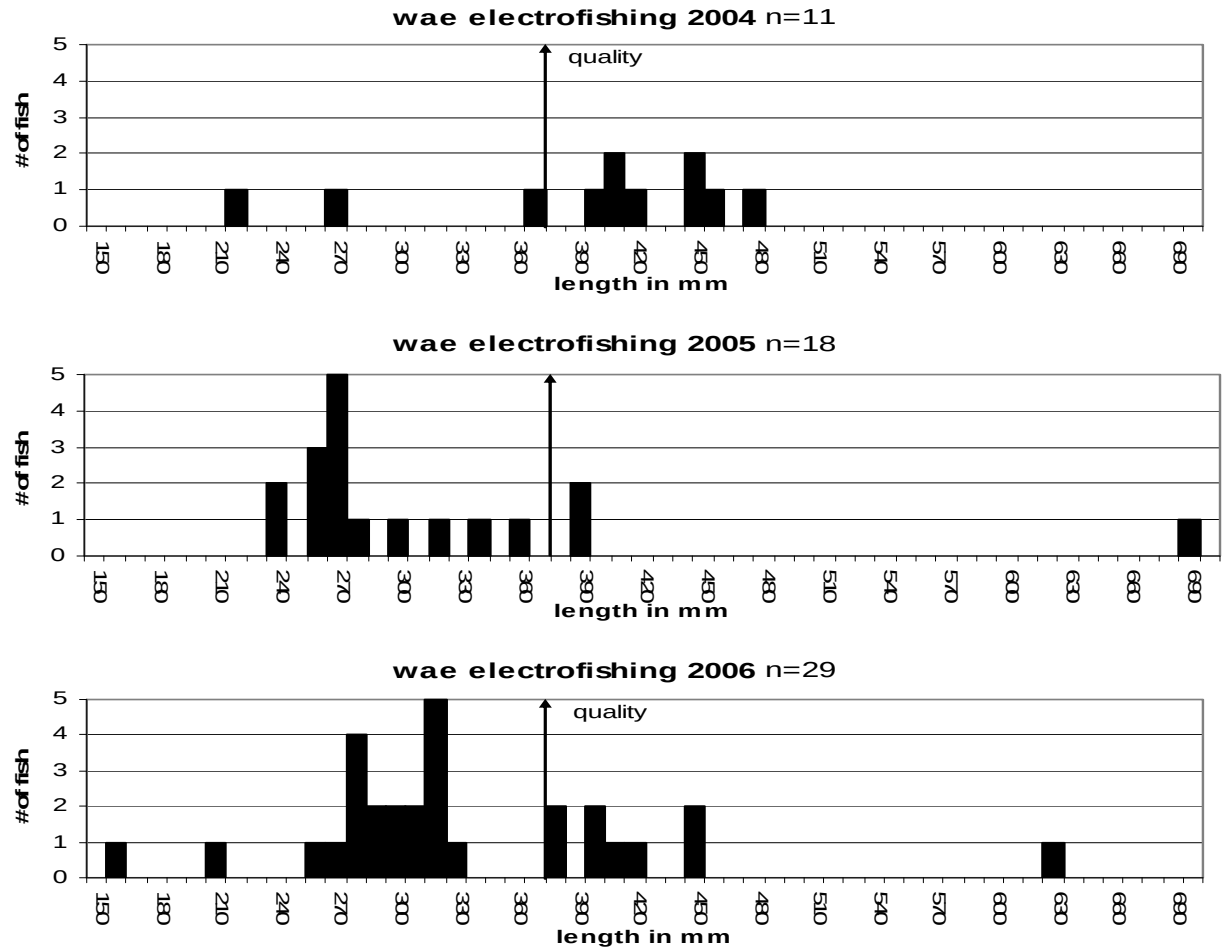


Figure 3. Lengths of walleye collected from fall electrofishing in Newell Lake, 2004-2006.

Yellow Perch

Yellow perch numbers remain low in Newell. During 2006, gillnet CPUE was 1.0, and trap net CPUE was 0.6, compared to 4.5 and 0.7 in 2004, respectively (Tables 2, 3 and 10). During ice-out in 2004, one hundred Christmas trees were placed in Newell Lake to provide yellow perch spawning habitat. Increased reproduction will hopefully provide forage for other game fish. In addition, it is hoped some of these fish recruit to the population and provide a better perch fishing opportunity.

Table 10 . Composite listing of sample size (N), catch-per-unit-effort (CPUE with 80% CI's), for yellow perch collected by gill nets and frame nets in Newell Lake, 1999 - 2006.

Year	Gill net CPUE	Frame net CPUE
1999	3.6 (--)	2.2 (--)
2002	5.0 (3.1)	2.4 (1.5)
2004	4.5 (1.5)	0.7 (0.5)
2006	1.0 (3.1)	0.6 (0.6)

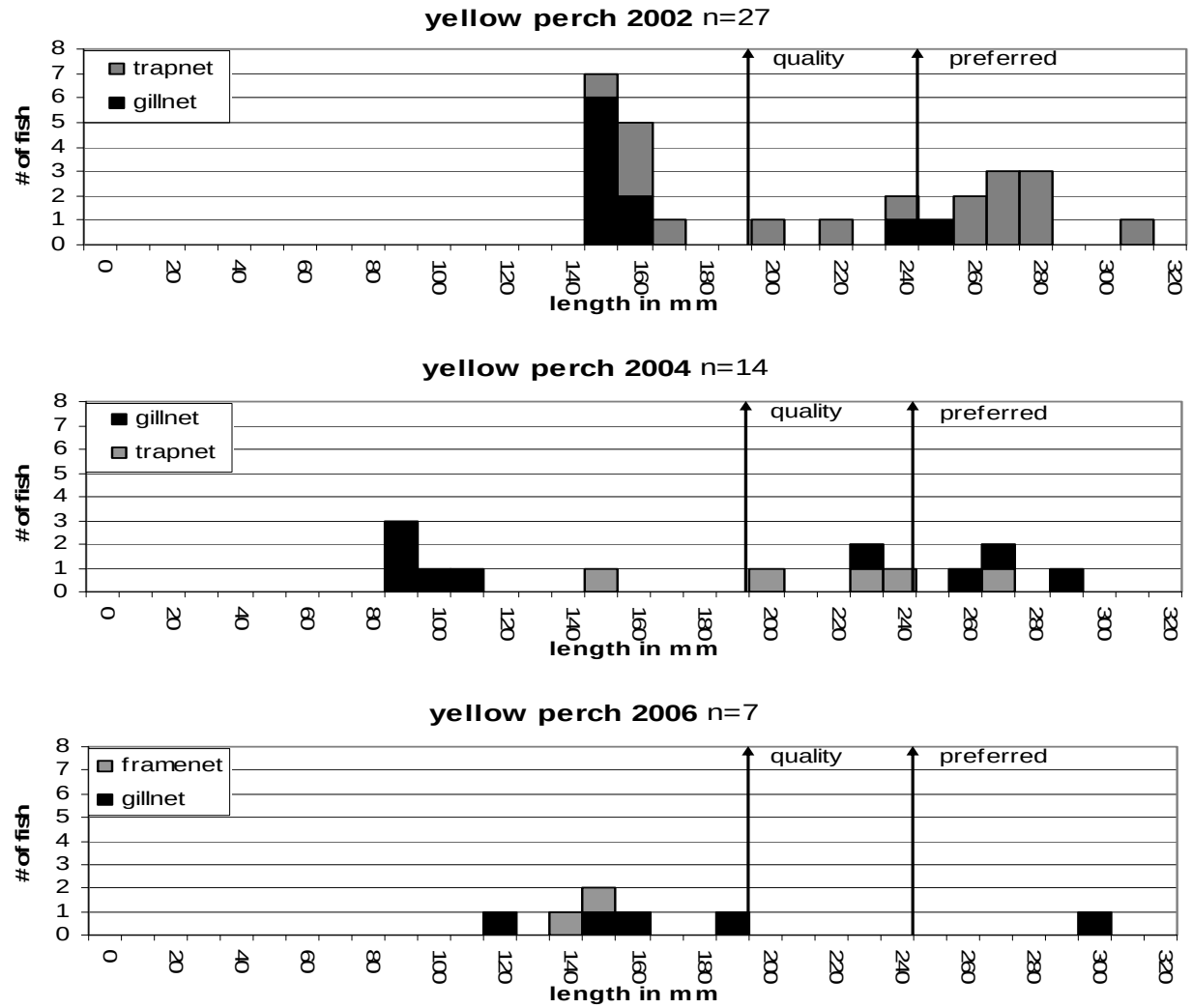


Figure 4. Length frequency histogram of yellow perch collected by frame nets and gill nets in Newell Dam 2002 - 2006.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Conduct standard lake surveys at least once every three years to monitor fish populations.

2. Sample largemouth bass, smallmouth bass and walleye annually by night electrofishing to identify population changes and effectiveness of new regulations.

3. Stock advanced walleye fingerlings biannually at a rate of 10 walleye per acre as a secondary predator and bonus fishery.

APPENDICES

Appendix A. Stocking record for Newell Lake, Butte County, 1995-2006.

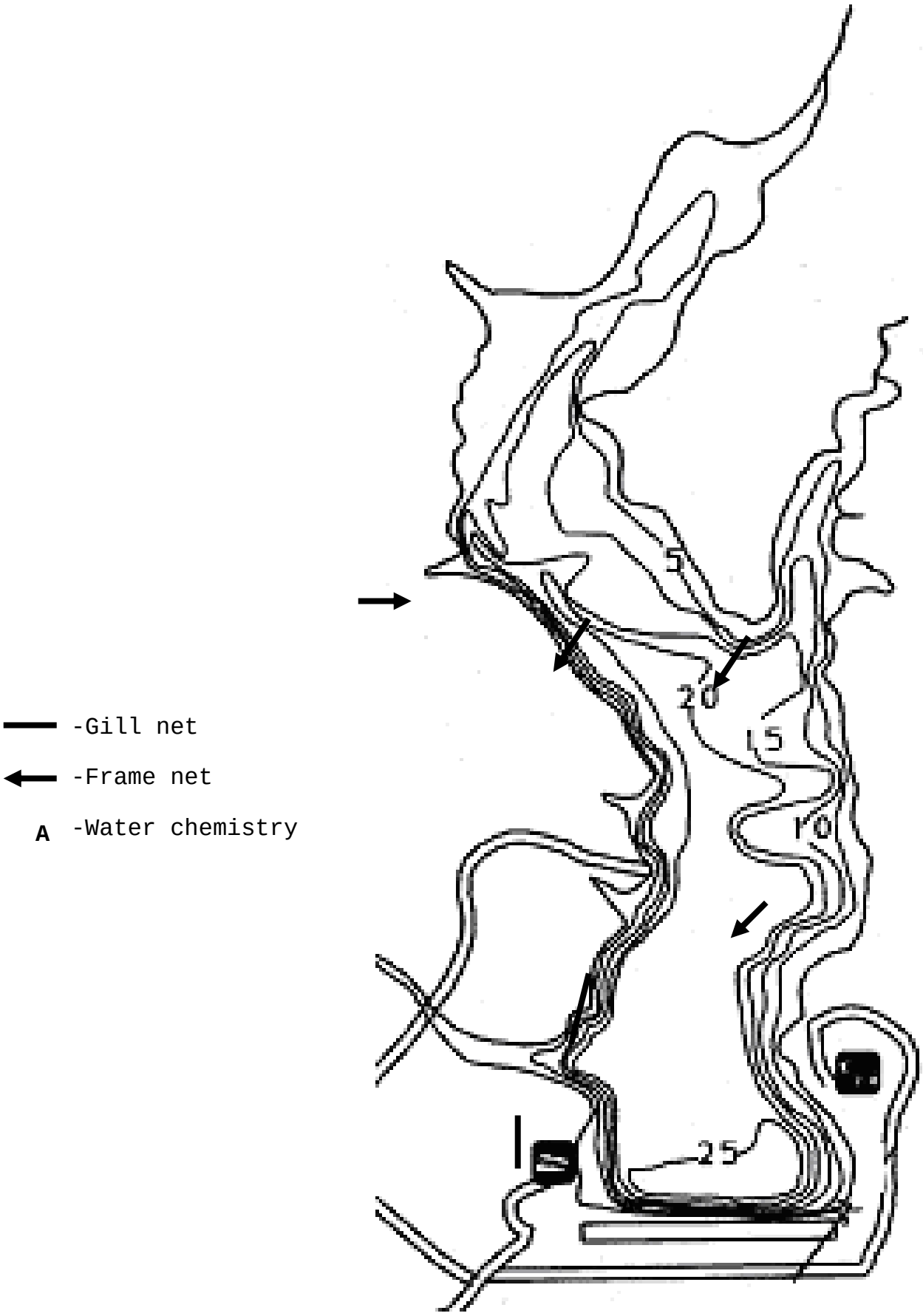
Year	Number	Species	Size
1995	20,000	Saugeye	Fingerling
1996	17,000	Largemouth bass	Fingerling
1997	4,200	Saugeye	Large fingerling
	18,400	Largemouth bass	Fingerling
1998	1,800	Saugeye	Advanced fingerling
2000	25,000	Saugeye	Fingerling
2001	100	Largemouth bass	Adult
2002	11,800	Largemouth bass	Fingerling

Appendix A. Continued

2003	1,120	Walleye	Large fingerling
2004	308	Walleye	Large fingerling
2005	2,230	Walleye	Large fingerling
2006	180	Largemouth bass	Adult
	187	Walleye	Large fingerling

Appendix B. Newell Lake water chemistry profile taken on August 1, 2006.

Depth(ft)	Temperature	Conductivity	Disolved O2	pH
1.8	23.0	921	7.3	8.2
3.2	22.8	922	7.4	8.2
5.0	22.5	924	7.4	8.2
7.2	22.2	928	7.1	8.1
10.5	23.7	922	7.2	8.2
13.5	23.0	922	7.2	8.2
16.9	23.7	920	6.9	8.2
20.1	23.7	921	6.8	8.2



Appendix C. Newell Lake net locations and water chemistry sites.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Newell City Pond County: Butte
Legal description: Sec. 25, T 9N, R 5E
Location from nearest town: 1.5 mi. W of Newell, SD
Dates of present survey: May 30-31, 2006
Dates last surveyed: May 22, 2003 and October 17, 2003
Most recent lake management plan: F21-R-2 Date: N/A
Management classification: Warmwater semi-permanent
Contour mapped: NA

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Walleye
2. Bluegill	2. White sucker
3. Northern pike	3. Common carp
4. Yellow perch	4. Shorthead redhorse

PHYSICAL CHARACTERISTICS

Surface Area: 20 acres; Watershed: 17,000 acres
Maximum depth: 27 feet; Mean depth: 12 feet
Lake elevation at survey (from known benchmark): full feet

1. Describe ownership of lake and adjacent lakeshore property:

Newell City Pond is 75% owned by the city of Newell with the remaining 25% under private ownership. Adjacent to the lake is the municipal golf course. Newell City Pond is a reserve water supply for this area.

2. Describe watershed condition and percentages of land use:

The Newell City Pond is adjacent to grass land and the Newell City municipal golf course.

3. Describe aquatic vegetative condition:

Submerged aquatic vegetation in Newell City Pond consists of coontail. Summer months are often characterized as having large amounts of vegetation in the shallow bays and inlets. Emergent vegetation consists of bulrush and cattail.

4. Describe pollution problems:

No pollution problems were identified during the 2006 survey.
5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No problems were noted in the 2006 survey. Newell City Pond does not have a boat ramp.

CHEMICAL DATA

1. Describe general water quality characteristics.
Field measurements included temperature and dissolved oxygen profile, surface pH, surface conductivity and transparency (Appendix B).

2. Thermocline: No

3. Secchi disc reading: not available

4. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted at Newell City Pond on May 30-31, 2006. Sampling consisted of one gill net and 4 trap net nights. All gill nets were monofilament experimental nets. Each net was 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at four stations consisting of 4 trap net nights each. All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.1 mm (0.75 inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the Smith-Root control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Newell City Pond is located ½ mile west of Newell, adjacent to the golf course. It's location near town should make this a popular fishery. The City Pond is full of small panfish in poor condition. Bluegill dominated the frame net catch making up 45.6% of the total number of fish caught with black crappie being second at 33.1% (Table 1). Yellow perch were the third most abundant at 18.8%. A single northern pike was sampled in the gill net. Population parameters of the dominant game fish species in Newell City Pond are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from four ¾ inch frame nets in Newell City Pond, May 31, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
BLC	53	13.3 (6.9)	13.3 (6.9)	2(3)	0(--)	84.2 (0.6)
BLG	73	18.3 (12.7)	18.3 (12.7)	58(10)	0(--)	99.4 (1.7)
GOS	2	0.5 (0.8)	--	--	--	--
GSF	1	0.3 (0.4)	0.3 (0.4)	--	--	95.0 (--)
NOP	1	0.3 (0.4)	0.3 (0.4)	--	--	80.4 (--)
YEP	30	7.5 (6.8)	7.5 (6.8)	0(--)	0(--)	83.7 (0.6)
Total	160					

Table 2. Total catch (N), catch per net night, catch per net night of stock length fish proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from a 150-ft experimental sinking gill nets in Newell City Pond, May 31, 2006

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
NOP	1	1.0	1.0			
Total	1					

Black Crappie

Newell City Pond has the classic characteristics of an overpopulated black crappie population. Frame net CPUE was 43.8 (Table 1). Two percent of the adult population has reached a quality size of 8 inches (Figure 1). Fish condition was poor with a Wr for stock length and larger fish of 84.2 (Table 1). Growth was extremely slow as shown in Table 4.

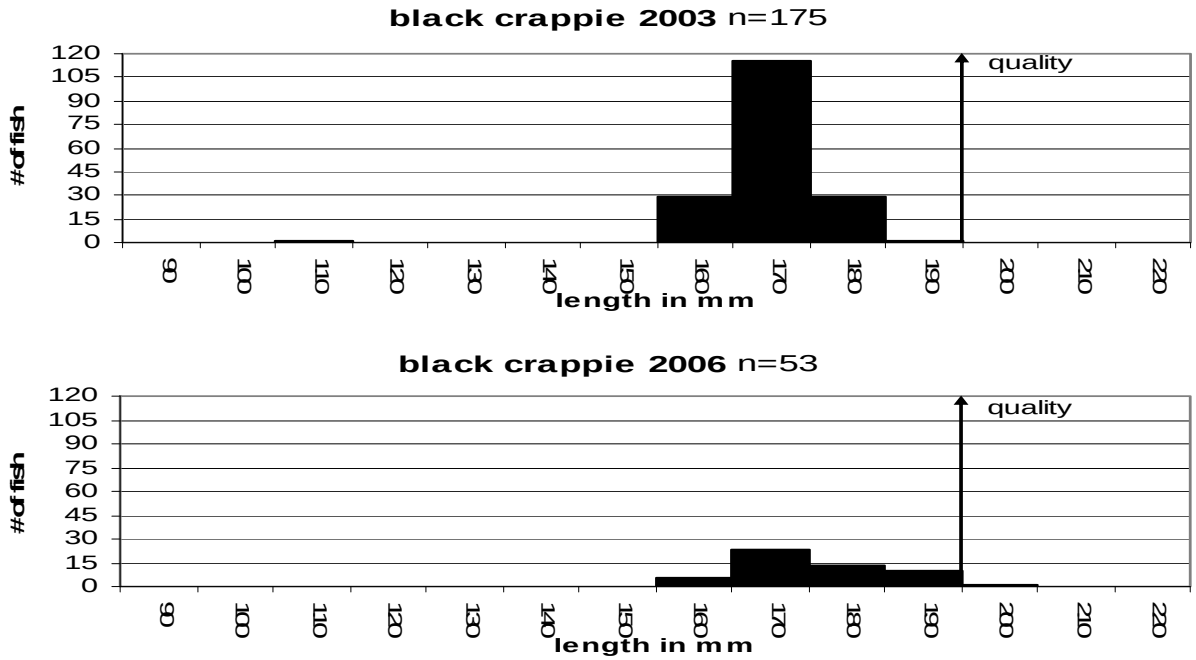


Figure 1. Length frequency histogram for black crappie sampled by frame nets in Newell City Pond, 2003,2006.

Table 4. Newell City Pond black crappie year class, age in 2006, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota black crappie mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2003	3	9	73	115	148		
2002	4	40	73	118	151	170	
2001	5	4	80	133	156	171	182
Sample size		53					
2006 Mean(SE)			**75(2)**	**122(5)**	**152(2)**	**171(0)**	**182(0)**
South Dakota(SE)			83(2)	147(4)	195(5)	229(6)	249(6)

Bluegill

The bluegill population is the only panfish species reaching quality length in decent numbers. Frame net CPUE was 18.3 with a PSD of 58. In 2003, frame net CPUE was 7.8 with a PSD of 71 and an RSD-P of 6. This survey fish condition was good with a Wr for stock-length and larger fish of 99.4.

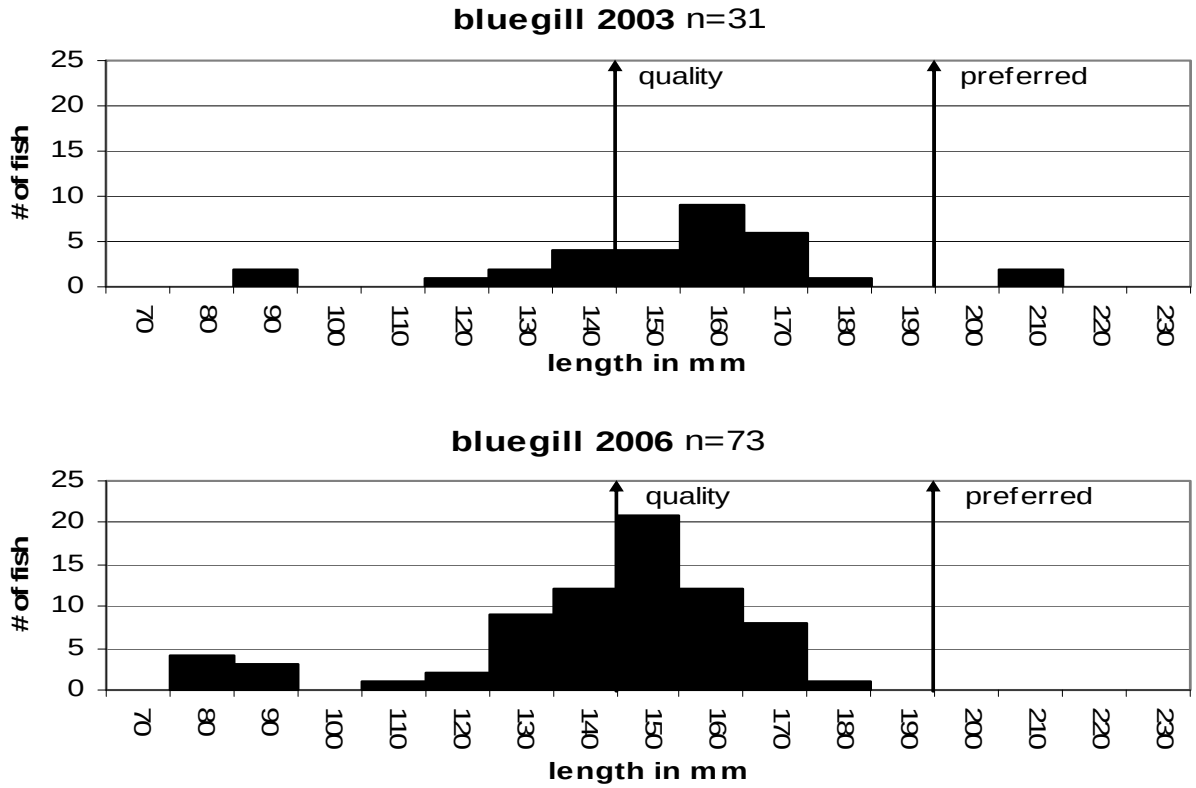


Figure 2. Length frequency histogram for bluegill sampled by frame nets in Newell City Pond, 2003, 2006.

Yellow Perch

The perch population may be suffering the most by the overpopulation of black crappie. Wr for stock length and over perch from the frame net sample was 83.7, up from 72.4 in 2003 (Table 1). Size structure was extremely poor, similar to 2003, with no fish sampled over quality length (Figure 4). Frame net CPUE was 7.5.

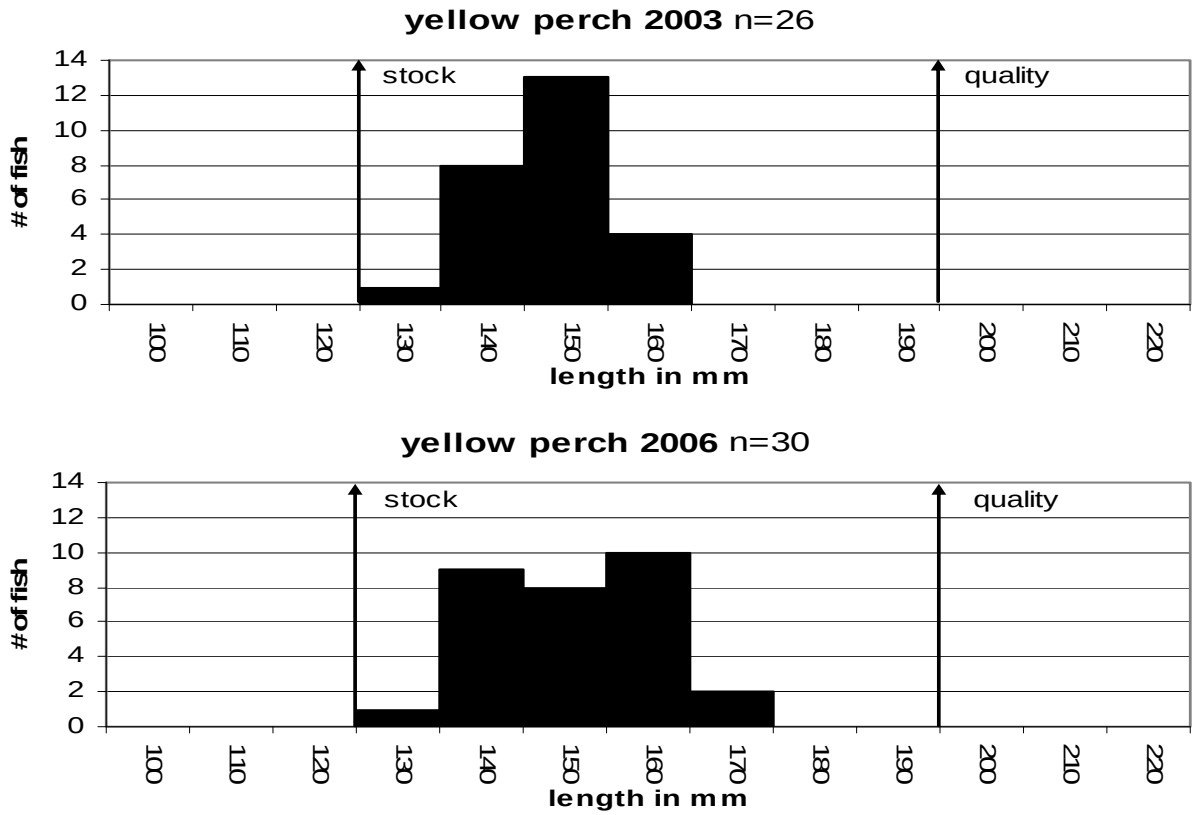


Figure 4. Length frequency histogram for yellow perch sampled by frame nets in Newell City Pond, 2003,2006.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

1. Stock adult largemouth bass at a rate of 10 per acre to increase bass density, which should help thin out the black crappie population. Continue to monitor the largemouth bass population through fall electrofishing.

APPENDICES

Appendix A. Stocking record for Newell City Pond, Butte County, 1990-2006.

Year	Number	Species	Size
1990	2400	Rainbow trout	Catchable
1997	2000	Largemouth bass	Fingerling
2006	200	Largemouth bass	Adult

Appendix B. Water chemistry results from on Newell City Pond, Butte County, August 30, 2006.

Depth (ft)	Temp (^{o}C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	19.9	8.38	8.18		
2.6	19.9	8.31	8.26		
4.7	19.9	8.29	8.29		
6.9	19.9	8.26	8.32		
9.3	19.9	8.25	8.34		
12.1	19.9	8.23	8.37		
14.2	19.9	8.22	8.38		
16.9	19.8	8.22	8.40		
18.8	19.8	8.10	8.40		
21.0	19.8	8.02	8.40		
23.2	19.8	7.97	8.39		

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Bismarck Lake County: Custer
Legal description: Sec. 22, T3S, R5E
Location from nearest town: 4 miles east and 1 mile north of Custer, South Dakota
Dates of present survey: 11 April, 3 May, and 19 October 2006
Date last surveyed: 29-31 March and 23 May 2005
Most recent lake management plan: F21-R-28 Date: 1994
Management classification: Coldwater Permanent
Contour mapped: 1993

Primary Species: (game and forage)
1. Hatchery rainbow trout
2. Brown trout

Secondary and other species:
1. Largemouth bass
2. Yellow perch
3. Black crappie
4. Black bullhead

PHYSICAL CHARACTERISTICS

Surface Area: 25 acres; Watershed: 2,048 acres
Maximum depth: 7.9 m (26 ft.); Mean depth: 3.7 m (12 ft.)
Lake elevation at survey (from known benchmark): ? feet

1. Describe ownership of lake and adjacent lakeshore property:

Bismarck Lake was originally built by the CCC in 1936 and is now owned by the U.S. Forest Service. The Bob Marshall camp adjoins the lake.

2. Describe watershed condition and land use:

The Bismarck Lake watershed consists of 70% conifer forest, 28% pasture, and 2% residential.

3. Describe aquatic vegetative condition:

Cattails exist along the north end of the lake and in other shallow areas. These shallow water areas are also where submerged vegetation exists.

4. Describe pollution problems:

Algae blooms occasionally occur during the summer months. Silt is collecting in the north bay.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

The dam appears to be in good condition. The boat ramp is in sufficient condition.

CHEMICAL DATA

Site A (Figure 1) was sampled on 23 August 2006 to measure water parameters (Table 1). Field measurements included depth, temperature, dissolved oxygen, pH, and transparency. Data was collected with an YSI model 6820 Multi-Parameter Water Quality Monitor and model 650 MDS data collector. Water transparency was estimated with a 20 cm Secchi disk.

Table 1. Water quality data from site A at Bismarck Lake, Custer County, South Dakota collected on 23 August 2006.

Depth (ft)	Temperature (^{o}C)	D.O. (mg/L)	pH	Secchi Disk (ft)	Total Po_4 (mg/L)
0.2	21.6	14.5	10.4	4.0	0.031
0.5	21.6	14.4	10.4		
1.2	21.6	14.5	10.4		
1.9	21.6	14.5	10.4		
2.9	21.6	14.6	10.4		
4.5	21.5	14.7	10.4		
6.1	21.1	15.0	10.3		
7.6	20.6	15.1	10.2		
9.4	20.1	14.8	10.0		
10.5	19.8	13.7	9.8		
11.6	19.5	10.4	9.7		
12.5	19.3	9.0	9.6		
13.7	18.7	7.6	9.5		
14.6	16.6	6.7	9.4		
15.5	15.3	4.8	9.2		
16.6	13.9	4.2	9.1		
17.9	12.7	3.7	9.0		
19.2	11.3	3.3	8.9		
20.4	10.7	2.6	8.8		
22.0	9.8	2.4	8.7		
23.2	9.0	2.2	8.6		
24.2	8.3	1.6	8.4		

BIOLOGICAL DATA

Methods

Frame netting was conducted on 10-11 April 2006. Sampling consisted of 9 trap net nights (Figure 1). All trap nets were modified fyke-nets with a 1.3 × 23 m (3.9 × 75.5-ft.) lead. Up to 100 fish captured of each species were measured (total length, mm) and weighed (g). Scales were collected from the first 5 fish of each centimeter group for yellow perch. Scale samples were pressed onto acetate slides and viewed with a microfiche projector and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 3.42 (Francis 1999).

Night electrofishing was conducted on 11 April 2006 to sample brown trout and again on 19 October 2006 to conduct brown trout food habits. Electrofishing was conducted using a Smith-Root 18-H electrofishing boat with pulsed-DC current at approximately 150 volts and 6-8 amps. One pass around the entire shoreline of the lake was completed for each survey. Only brown trout were collected, measured (TL, mm), and weighed (g). Fin clips were noted to differentiate separate stockings. Data was entered into WinFin 3.42.

Fish population parameters, confidence intervals, and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD), and relative weight (Wr) based on length categories. Abundance was expressed as mean CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

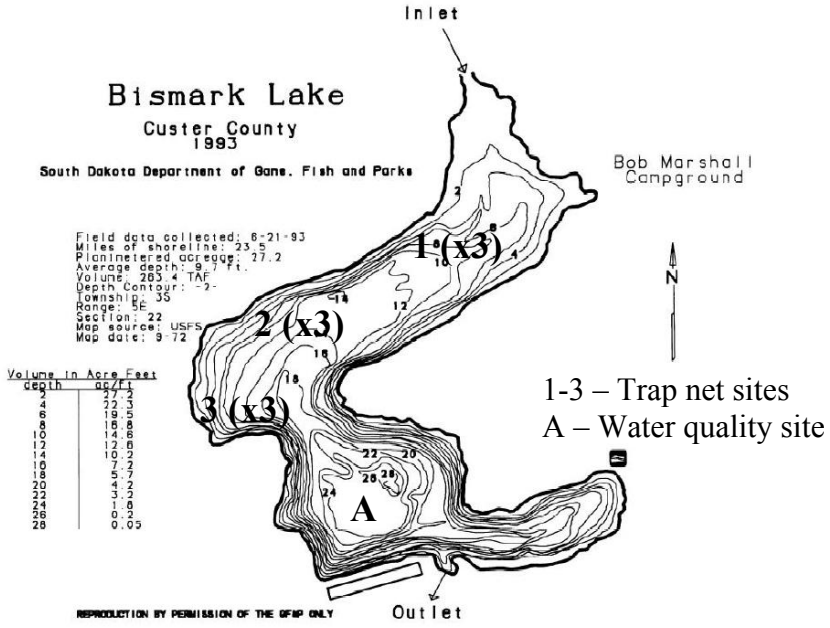


Figure 1. Lake map and sampling locations of Bismarck Lake, Custer County, South Dakota.

RESULTS AND DISCUSSION

Bismarck Lake is managed primarily as a put-and-take rainbow trout fishery. However, numerous yellow perch and black crappie also exist in the lake. Brown trout were first stocked in the spring of 2004 and again in the spring of 2005 to utilize the panfish as forage. The goal of the brown trout stockings is to provide some control of these panfish and to grow them to trophy size. Largemouth bass, northern pike, and black bullheads also exist in this lake.

Six different species of fish were caught in trap nets (Table 2). Yellow perch were most numerous of all species sampled. Recently stocked rainbow trout were released without collecting data.

Table 2. Total catch for 9 trap net nights at Bismarck Lake, Custer County, South Dakota from 10-11 April 2006. Total number, catch per net night of stock length fish (CPUE-S, 80% CI), proportional stock densities (PSD, RSD-P with 90% CI), and condition factor (Wr for fish ≥ stock length) are reported.

Species	N	CPUE-S	PSD	RSD-P	Wr≥S
Black bullhead	27	1.9 (1.6)	71 (19)	6 (10)	91.0
Hatchery brown trout	3	0.3 (0.2)	--	--	95.2
Hatchery rainbow trout	NA	NA	NA	NA	NA
Largemouth bass	1	0.1 (0.1)	0	0	104.5
Northern pike	6	0.3 (0.5)	67 (33)	0	100.1
Yellow perch	376	11.2 (13.1)	87 (6)	2 (2)	97.2
Total	**413**				

During night electrofishing, only brown trout were collected. From the 2004 stocking (determined by lack of fin clip), 42 browns were sampled in 2006 compared with 38 browns in 2005. Sixteen from the 2005 stocking (determined by adipose clip) were caught this year compared to 5 sampled from 2005 electrofishing (Table 3).

Table 3. Total catch from 3,448 seconds (57min 30 sec) of night electrofishing at Bismarck Lake, Custer County, South Dakota on 03 May 2006.

Species	N	CPUE	Wr
Hatchery brown trout (2004 stocking, no clip)	42	43.9	109.1
Hatchery brown trout (2005 stocking, adipose clip)	16	16.7	101.8
Total	**58**		

Yellow perch

The yellow perch PSD in 1994 was 89 and growth was above the means of regional and state means. In the next ten years, it appeared that the perch numbers increased and growth slowed probably due to competition factors and lack of predator control. In 2004, the PSD was only 21 and growth was below state means (Figures 2 and 3). Approximately 2,400 perch (total) were manually removed from Bismarck from 2004 – 2006 to be transferred to other waters. Additionally, brown trout have been stocked for some predatory control on the perch. The PSD in 2005 increased to 57 in 2005 and again in 2006 to 87. An RSD-P was recorded this year for the first time since 1994. The length frequency histograms illustrate the difference in population size structures from 1994 to 2006 (Figure 4).

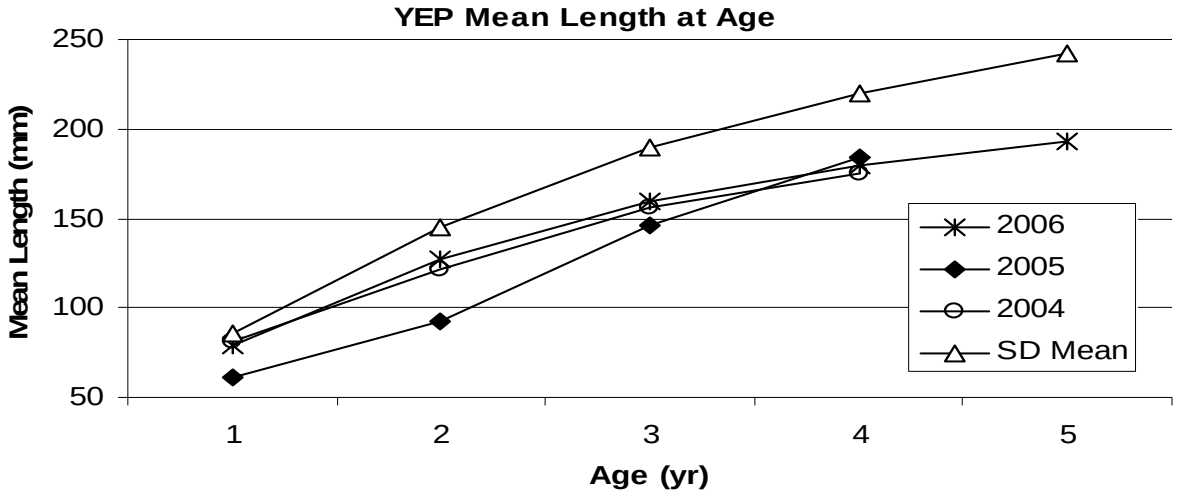


Figure 2. Mean length at age for yellow perch at Bismarck Lake, Custer County, South Dakota.

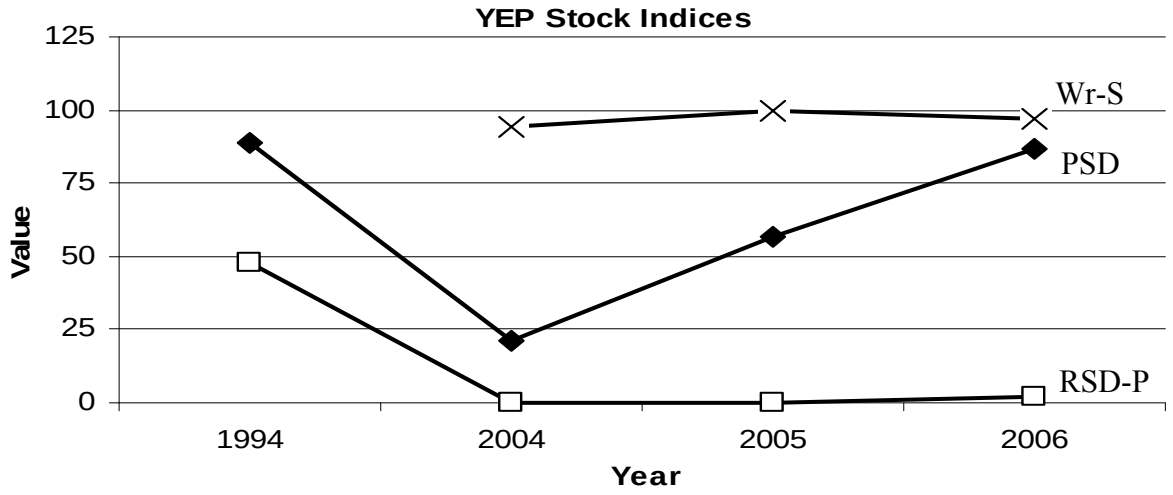


Figure 3. Stock density indices and Wr-S for yellow perch collected from trap nets at Bismarck Lake, Custer County, South Dakota for 1994 and 2004-2006.

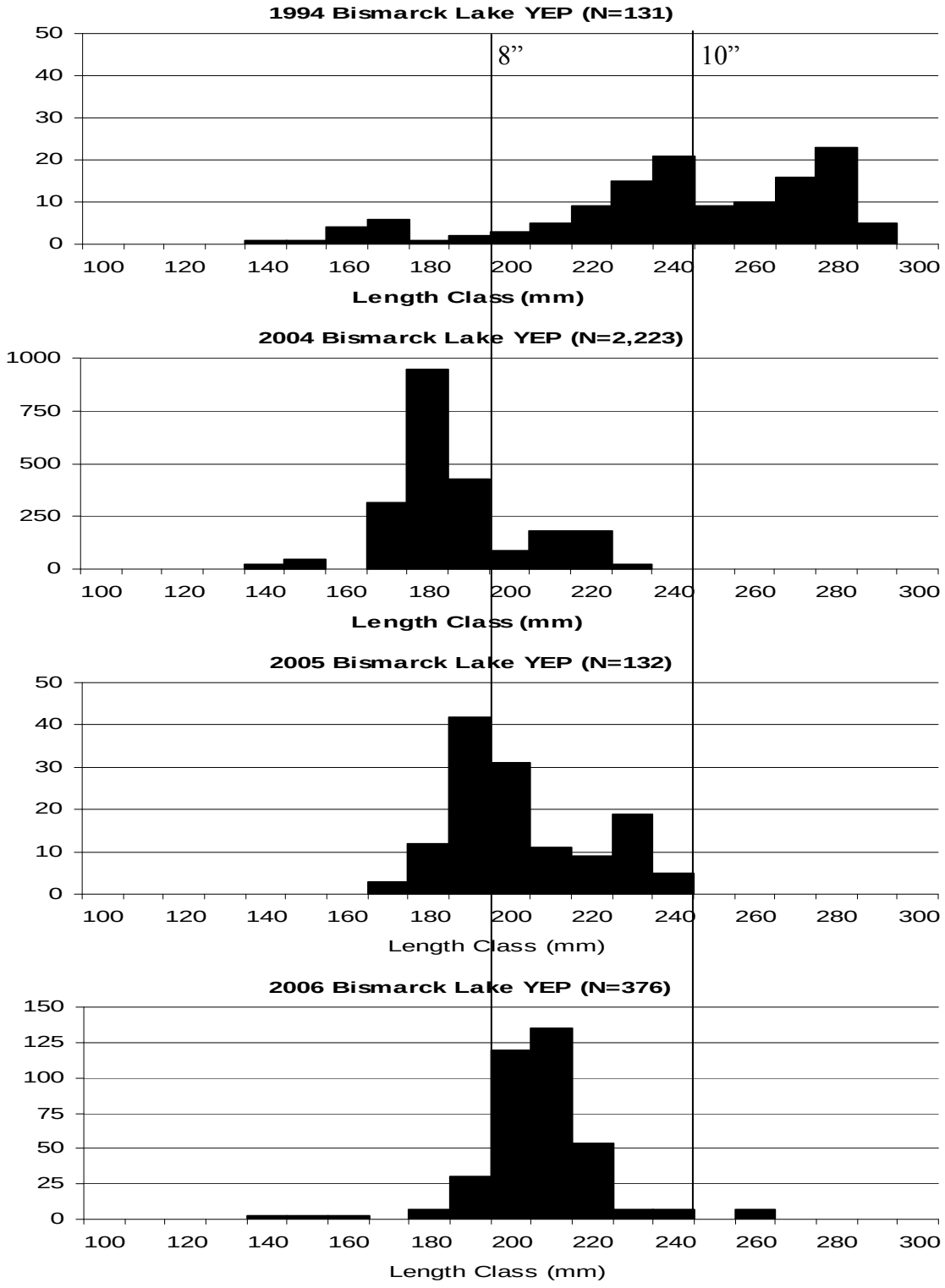


Figure 4. Length frequency histograms for yellow perch collected in trap nets from Bismarck Lake, Custer County, South Dakota in 1994 and 2004-2006. The solid lines represent quality and preferred lengths of 8 and 10 inches.

Black crappie

The black crappie population appears to be declining. CPUE of stock length crappie was near 50 in 2004, dropping substantially to below5 in 2005 and none were sampled in 2006 (Figure 5). The 2004 PSD was 54 with an RSD-P of 0. In 2005, the PSD was 55 and again, the RSD-P was 0. The estimated growth for black crappie in Bismarck Lake was slow compared with regional and state means, but is slightly better than in 2004 (Figure 6). The length frequency histograms indicate that the size structure of black crappie population has not changed much over the last two years (Figure 7).

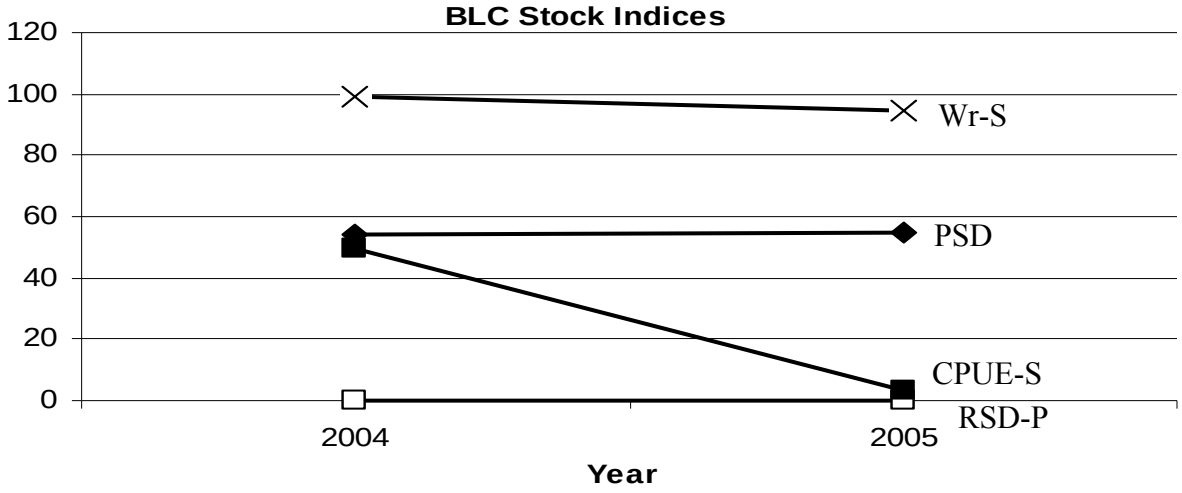


Figure 5. Stock density indices, CPUE-S and Wr-S for black crappie sampled from Bismarck Lake, Custer County, South Dakota in 2004 and 2005.

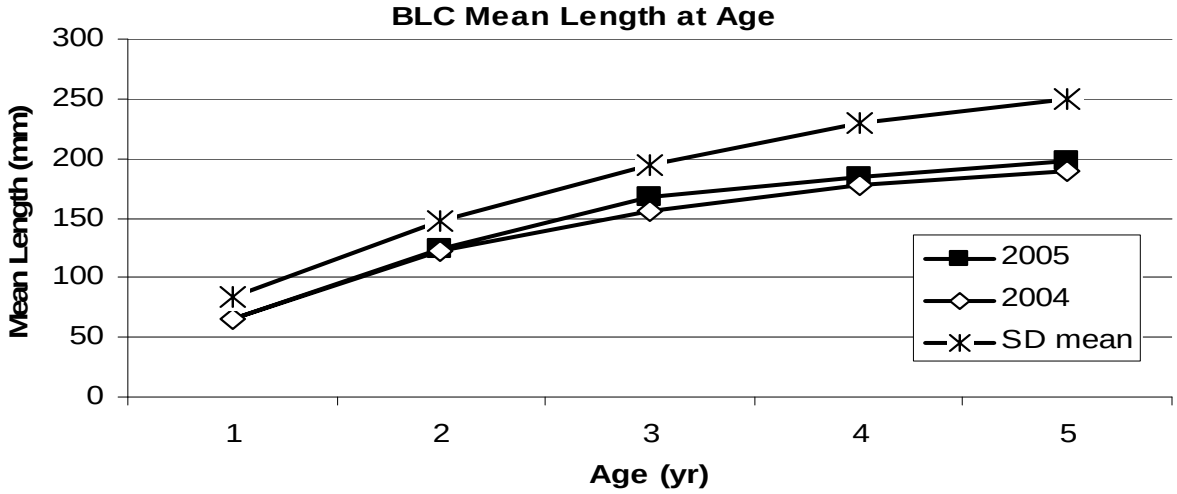


Figure 6. Mean length at age for black crappies sampled from Bismarck Lake, Custer County, South Dakota.

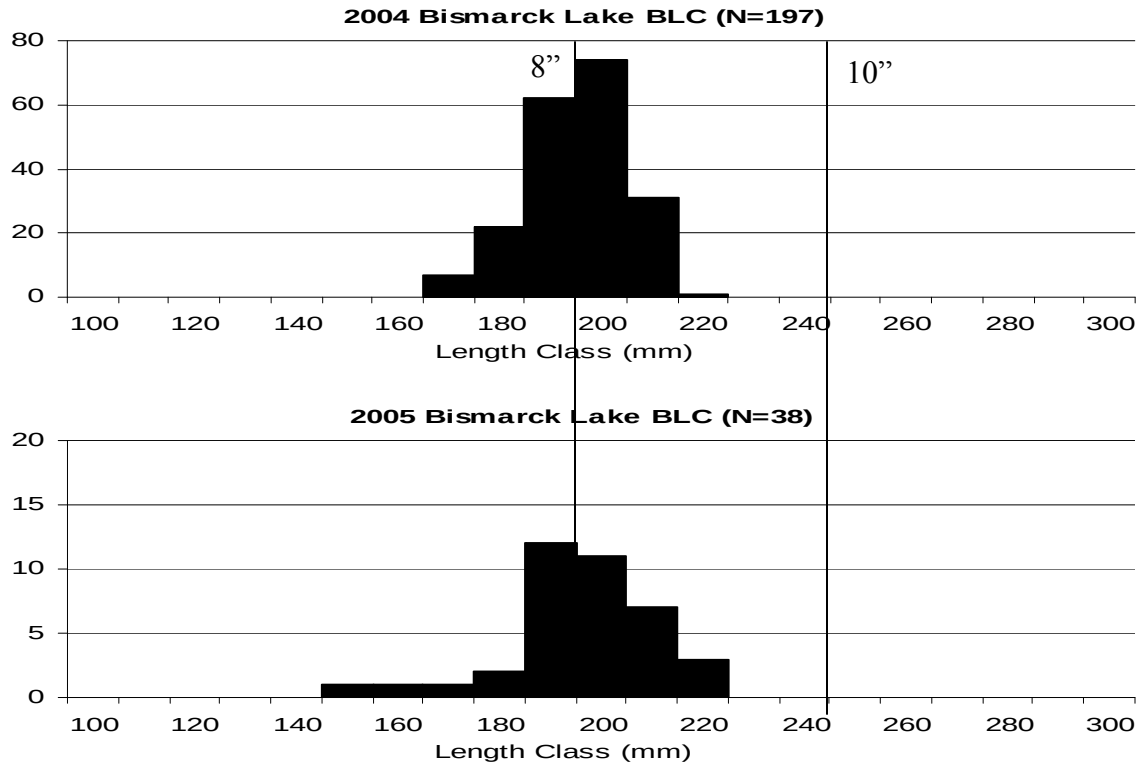


Figure 7. Length frequency histogram for black crappie sampled in trap nets from Bismarck Lake, Custer County, South Dakota. The solid lines represent quality and preferred lengths (8 and 10 inches).

Brown Trout

There were 20 more brown trout sampled during night electrofishing in 2006 than 2005, indicating that survival remains excellent. The results of the two groups of browns stocked in separate years are reported in Table 3. The overall mean Wr was 107.1, which is excellent. The length frequency graphs are suggesting that the brown trout are growing well (Figure 8). Several browns are over 14 inches in length and one sampled was nearly 17 inches long. Thus far, the brown trout stocking program continues to do well in Bismarck Lake. There have been several anecdotal reports from WCOs and fisherman catching these browns.

A small food habits study was conducted in October 2006 to examine what the brown trout were eating. Thirty fish were sampled and wet weights of stomach contents were measured. The results are presented in Table 4.

Table 4. Stomach contents taken from brown trout in Bismarck Lake, Custer County, South Dakota.

Year	Season	N	% Empty	% Inverts	% Plankton	% Fish	% Other
2006	Fall	30	10	75.7	0.0	0.2	24.1

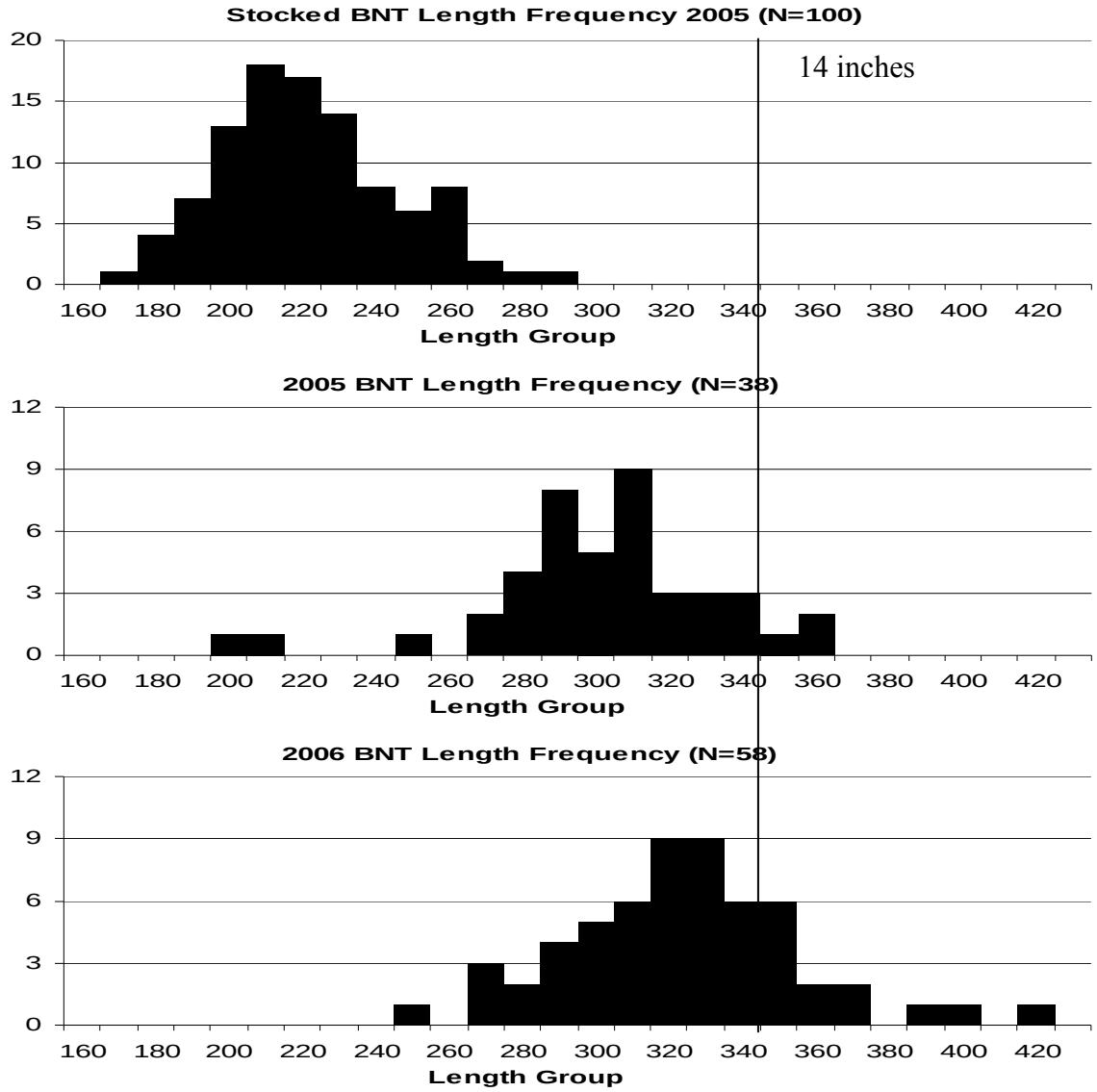


Figure 8. Length frequency histogram for hatchery brown trout sampled by electrofishing from Bismarck Lake, Custer County, South Dakota. The solid line represents 14 inches of length.

Other Species

Largemouth bass, black bullheads, and northern pike were also caught in the trap nets, but in low numbers. Rainbow trout were also captured in the trap nets and were in excellent condition. A stocking of rainbows had occurred within a couple of weeks prior to this survey, so the rainbows sampled were likely those.

RECOMMENDATIONS

1. Conduct night electrofishing in the spring of 2007 to sample brown trout for growth, survival, and condition.

2. Conduct food habits on brown trout in the spring and summer.

3. Conduct a trap net survey in the spring of 2007 to sample YEP and BLC stock indices and growth.

4. Conduct night electrofishing in the fall of 2007 to sample largemouth bass to compare 2003 numbers and size structures.

5. Continue with normal rainbow trout stockings.

REFERENCES

Francis, J. 1999. WinFin, Version 3.42; Microsoft Access Program for data entry. Nebraska Game and Fish Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.7. Nebraska Game and Fish Commission, Lincoln.

APPENDIX

Appendix 1. Stocking record for Bismarck Lake, Custer County, South Dakota from 1996 through 2006.

Species	Year	Number	Size
Rainbow trout	1996	40	adult
		12,110	catchable
Rainbow trout	1997	40	adult
		7,600	catchable
Rainbow trout	1998	30	adult
		7,600	catchable
Rainbow trout	1999	7,600	catchable
Rainbow trout	2000	9	adult
		7,600	catchable
Rainbow trout	2001	5,250	catchable
Rainbow trout	2002	30	adult
		2,850	catchable
Rainbow trout	2003	3,149	catchable
Rainbow trout	2004	170	adult
		3,585	catchable
Brown trout	2005	625	catchable
Rainbow trout		3,345	catchable
		400	adult
Rainbow trout	2006	4,085	catchable
		485	adult

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102 - F21-R-39

Name: Center County: Custer
Legal description: T3S, R6E, Sec.8&9
Location from nearest town: 8E, 3N, 1/2E Custer (Custer State Park)
Dates of present survey: 5-6 July 2006
Date last surveyed: 18-19 October 1994
Most recent lake management plan: F-21-R-26 Date: 1992
Management classification: Coldwater Permanent
Contour mapped: Yes Date: 1987

Primary Species: (game and forage)
1. Hatchery Rainbow Trout

Secondary and other species:
1. White Sucker
2. Creek Chub

PHYSICAL CHARACTERISTICS

Surface Area: 26.5 ac. (10.7 ha.) Watershed: 4,992 ac. (2,021.8 ha.)
Maximum depth: 40 ft. (12.2 m) Mean depth: 17 ft. (5.2 m)
Lake elevation at survey (from known benchmark): full

1. Describe ownership of lake and adjacent lakeshore property:

The Parks Division of the South Dakota Game, Fish, and Parks (SDGFP) owns and maintains the lake and adjacent shoreline.

2. Describe watershed condition and percentages of land use:

The watershed above Center Lake is primarily public timberland administered by SDGFP. A small portion of the upper end of the watershed lies outside Custer State Park boundaries and is administered by the U. S. Forest Service. Private cabins, a campground, and a summer theater are located immediately above the lake. A swimming beach is located on the southwest shoreline. Grace Coolidge Creek, a tributary of Battle Creek, is the main water source for Center Lake. A walk-in fishery is located downstream on Grace Coolidge Creek and its associated lowhead dams.

3. Describe aquatic vegetative condition:

Emergent vegetation (cattails and bulrush) exists in the inlet region. Submergent forms are evident in littoral areas along much of the shoreline excluding the spillway area.

4. Describe pollution problems:

Moderate pollution and sedimentation likely occurs due to camping activities and adjacent roads. Some silt was removed in 1973 after drawing down the reservoir level prior to nongame fish eradication. The construction of a hard surfaced road and camping pads in 1973-1974 appears to have lessened the impacts of erosion.

5. Describe condition of all structures, i.e. spillway, level regulators, boatramps, etc.:

Center Lake was constructed in the 1930s by the Civilian Conservation Corps. The dam and spillway appear to be structurally sound. The control structure was repaired in 1965 after a draw down prior to fish eradication. One improved boat ramp and dock exist on the north shore.

CHEMICAL DATA

Center Lake (Figure 1) was sampled on 5 July and 3 August 2006 to measure water parameters (Table 1). Field measurements included depth, temperature, dissolved oxygen, pH, and conductivity. Data was collected by the DENR. Sufficient oxygen levels with low enough temperatures for trout are present even during the hot month of August.

Table 1. Water quality data from Center Lake, Custer County, South Dakota collected on 5 July and 3 August 2006.

Date	Depth	Temperature	D. O.	pH	Conductivity
5-Jul	7.1	21.3	11.7		123
5-Jul	10.6	19.6	14.7		122
5-Jul	13.5	15.7	13.3		122
5-Jul	20.2	11.0	3.1		124
5-Jul	23.5	9.4	1.7		125
5-Jul	26.4	8.8	0.5		127
5-Jul	30.5	8.2	0.3		130
3-Aug	6.8	22.2	7.7	9.0	125
3-Aug	10.4	21.6	7.5	8.9	125
3-Aug	13.5	21.0	7.7	8.9	125
3-Aug	17.0	15.4	8.1	8.3	120
3-Aug	20.5	12.7	0.6	7.4	121
3-Aug	24.0	10.2	0.3	7.1	127
3-Aug	27.3	8.9	0.2	7.0	131
3-Aug	30.2	8.4	0.2	7.0	133
3-Aug	34.0	8.0	0.2	6.8	141
3-Aug	38.2	7.7	0.2	6.6	159

BIOLOGICAL DATA

Gill and frame netting were conducted on 5-6 July 2006. Sampling consisted of 1 gill net night and 3 trap net nights (Figure 1). All gill nets were monofilament, experimental nets and were 45.7 m (150-ft.) long and 1.8 m (6-ft.) deep with six 7.6 m (25-ft.) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). All trap nets were modified fyke-nets with a 1.3 × 23 m (3.9 × 75.5-ft.) lead. Up to 100 fish captured of each species were measured (total length, mm) and weighed (g). All data was entered into WinFin 3.42 (Francis 1999).

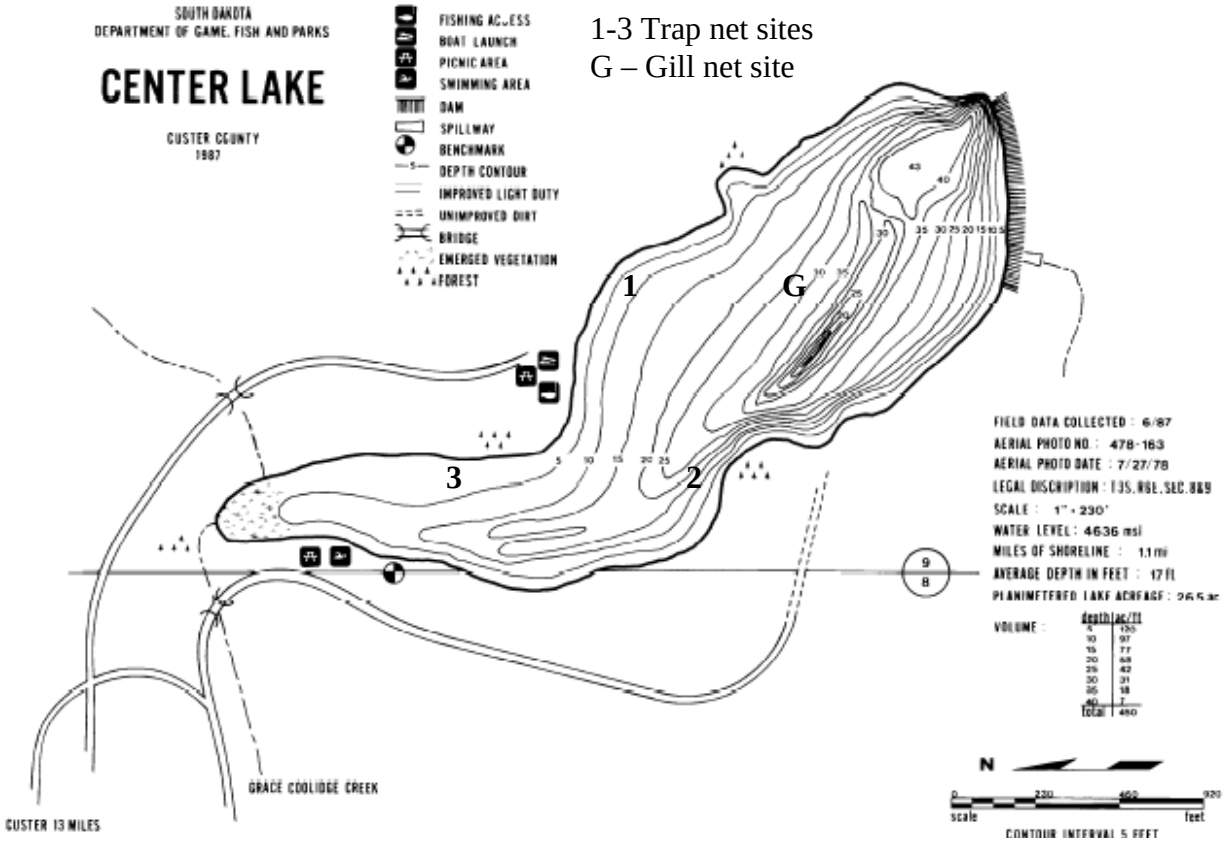


Figure 1. Lake map and sampling locations on Center Lake, Custer County, South Dakota.

RESULTS AND DISCUSSION

Center Lake's primary purpose has been a put-and-take rainbow trout fishery. In past surveys as well as the current survey, white suckers and chubs have been present in the lake. These were the only three species caught in gill and trap nets (Tables 2 and 3). There were high numbers of

suckers. The rainbow trout seemed to be in good condition.

Table 2. Total catch for 3 trap net nights at Center Lake, Custer County, on 6 July 2006. Total number, catch per net night, and mean length are reported.

Species	N	CPUE	Mean Length
Hatchery rainbow	9		
White sucker	153	15 (21.2)	224.7
Creek chub	21	7 (6.6)	183.5
Total	**183**		

Table 3. Total catch for 1 gill net night at Center Lake, Custer County, on 6 July 2006. Total number, catch per net night, and mean length are reported.

Species	N	CPUE	Mean Length
Hatchery rainbow	14	14	333.4
White sucker	67	67	292.9
Total	**81**		

RECOMMENDATIONS

1. Continue with normal rainbow trout catchable stockings.

2. Stock brown trout as a predatory salmonid to utilize chub and white sucker populations in an attempt to reduce densities of these species and possibly provide trophy trout for anglers.

3. Conduct an electrofishing survey in 2007 to determine if other species (i.e. largemouth bass) are present in the lake.

4. Conduct more extensive netting surveys after brown tout stockings to determine influences on the white sucker and creek chub populations and consider a seasonal food habits study of brown trout to determine extent of predation within the lake.

APPENDIX

Appendix 1. Stocking history for Center Lake, Custer County, South Dakota.

Species	Year	Number	Size
RBT	1984	9,300	catchable
RBT	1985	8,400	catchable
RBT	1986	160	adult
		8,400	catchable
RBT	1987	42	adult
		9,435	catchable
RBT	1988	10,400	catchable
		8,500	fingerling
RBT	1989	500	adult
		8,403	catchable
RBT	1990	200	adult
		8,400	catchable
BNT	1991	60	adult
RBT		140	adult
		9,540	catchable
RBT	1992	270	adult
		8,400	catchable
RBT	1993	8,400	catchable
RBT	1994	8,055	catchable
RBT	1995	51	adult
		8,700	catchable
RBT	1996	8,300	catchable
RBT	1997	45	adult
		5,225	catchable
RBT	1998	5,225	catchable
RBT	1999	10	adult
		5,340	catchable
RBT	2000	31	adult
		5,225	catchable
RBT	2002	30	adult
		5,900	catchable
		5,000	fingerling
RBT	2003	50	adult
		3,700	catchable
RBT	2004	460	adult
		5,500	catchable
RBT	2005	3,920	catchable
RBT	2006	6,803	catchable

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Stockade Reservoir County: Custer
Legal description: Sec 21, 22, 27, and 28; R5E; T3S
Location from nearest town: 3 miles east of Custer, SD
Dates of present survey: 8 May, 7-8 September 2006
Dates last surveyed: 13-14 September, 26 October 2005
Most recent lake management plan: 1997 (for period of 1998 to 2002)
Management classification: Coldwater marginal
Contour mapped: June 1986

Primary Species: (game and forage)
1. Largemouth bass
2. Smallmouth bass
3. Yellow perch
4. Black crappie
5. Brown trout

Secondary and other species:
1. Rainbow trout
2. Black bullhead
3. Golden shiner
4. White sucker
5. Northern pike

PHYSICAL CHARACTERISTICS

Surface Area: 130 acres Watershed: 42,880 acres
Maximum depth: 13.7 m (45 feet) Mean depth: 4.8 m (15.8 feet)
Lake elevation at survey (from known benchmark): full

1. Describe ownership of lake and adjacent lakeshore property:

Stockade Lake is owned by the State of South Dakota and lies within the boundaries of Custer State Park.

2. Describe watershed condition and percentages of land use:

Primary use of the Stockade Lake watershed includes timber sales (60%) administered by the U.S. Forest Service (USFS), grazing (20%), municipal water use (15%), and mining (5%). Cattle grazing has occurred on private and USFS land surrounding the lake. Bismarck Lake has a surface area of 25 acres and drains into one of Stockade Lake's north bays. Custer Municipal Pond has an estimated surface area of 4 acres and is located on French Creek above Stockade Lake on Custer's west edge of town.

3. Describe aquatic vegetation condition:

Cattails were present along shorelines with shallow areas and also in bays. Submerged vegetation consisted mostly of pondweed in shallow, shoreline areas. Summer algae blooms have sometimes been heavy and contributed to past summer kills.

4. Describe pollution problems:

Siltation and nutrient loading into Stockade Lake has occurred from highway runoff, grazing, mining, and forestry practices via French Creek and Bismarck Lake Creek. The sewage treatment facility for the city of Custer was upgraded over the years, so city waste no longer enters the lake. From 1987 to 1990, silt removal from the French Creek inlet was accomplished by dredging and construction equipment (i.e. loaders and dump trucks).

5. Describe condition of all structures:

The aeration system, run by a 5-hp Quincy air pump, had no problems in 2006. Some airline tubing from the aeration system needed repair and was fixed by staff. All other equipment and structures appeared in good condition.

CHEMICAL DATA

Water chemistry was conducted at Stockade, site A on 23 August 2006 (Table 1, Figure 1). Field measurements included temperature, pH, and dissolved oxygen. All were taken with an YSI model 6820 Multi-Parameter Water Quality Monitor and model 650 MDS data collector.

Table 1. Water quality data for Stockade Reservoir, Custer County, South Dakota.

Depth (feet)	Temperature (^{o}C)	D.O. (ppm)	pH
2.2	22.5	12.1	9.5
4.3	22.1	12.4	9.6
5.9	21.9	12.5	9.6
8.1	21.5	12.5	9.6
10.8	21.2	12.0	9.5
12.3	21.0	11.6	9.4
14.1	20.9	11.1	9.4
17.2	20.7	9.7	9.3
18.5	20.4	9.0	9.1
19.5	20.0	7.8	9.1
20.1	19.6	5.2	9.0
22.1	17.7	3.2	8.8
23.9	16.5	2.1	8.7
26.5	15.2	1.6	8.6
28.0	14.4	1.3	8.5
30.7	13.0	1.1	8.4
32.0	12.5	1.0	8.4
34.8	11.7	0.9	8.3
36.8	11.1	0.8	8.2
38.5	10.8	0.7	8.1
39.5	10.5	0.6	7.8

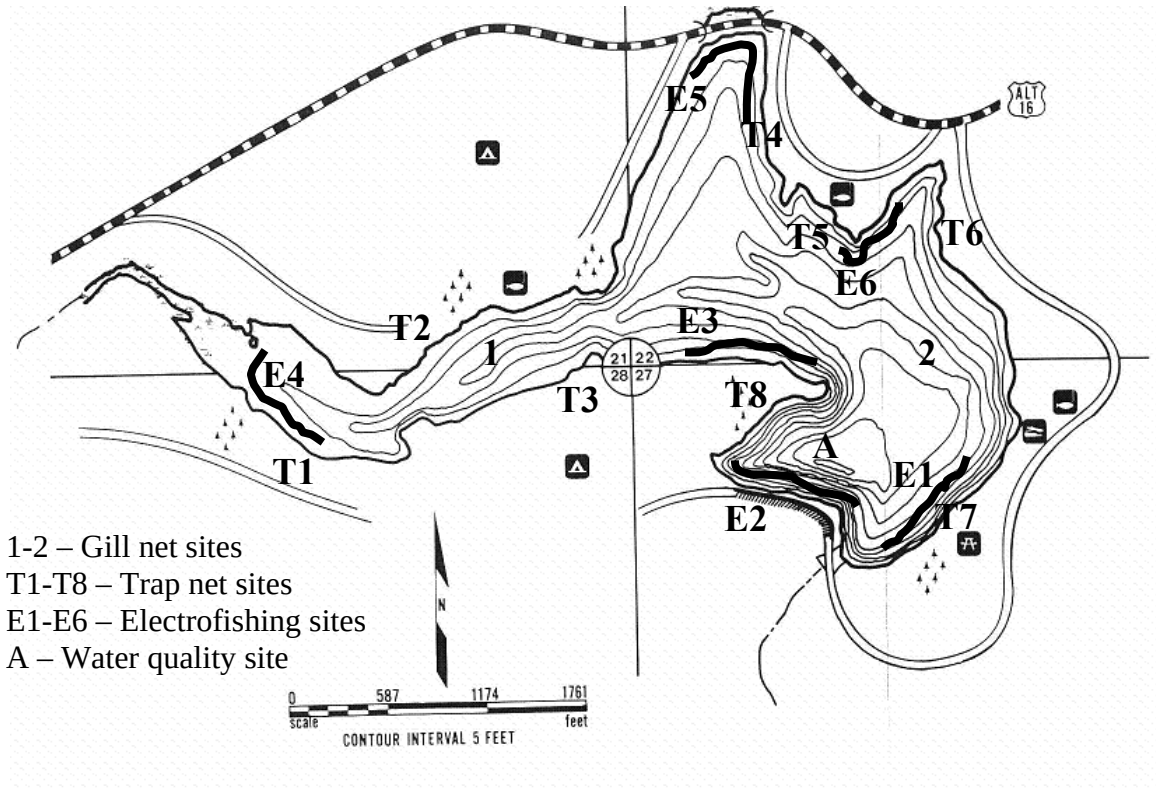


Figure 1. Lake map and sampling sites at Stockade Reservoir, Custer County, South Dakota.

BIOLOGICAL DATA

Gill and trap netting was conducted 7-8 September 2006. Sampling consisted of 2 gill net nights and 8 trap net nights (Figure 1). All gill nets were monofilament, experimental nets and were 45.7 m (150-ft.) long and 1.8 m (6-ft.) deep with six 7.6 m (25-ft.) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at 8 different stations, one net night each. All trap nets were modified fyke-nets with a 1.3 × 23 m (3.9 × 75.5-ft.) lead. All fish captured were measured (total length, mm) and weighed (g). Scales were collected from the first 5 fish of each centimeter group for black crappie collected from trap nets and yellow perch collected from gill nets. Scale samples were pressed onto acetate slides and viewed with a microfiche projector and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 3.42 (Francis 1999).

Night electrofishing was conducted at Stockade Lake on 8 May 2006 to sample brown trout. Electrofishing was not conducted in the fall for largemouth bass. Electrofishing was conducted using a Smith-Root 18-H electrofishing boat with pulsed-DC current at approximately 150 volts and 6-8 amps. Six ten-minute sites were completed during the survey (Figure 1). Data was entered into WinFin 3.42.

Fish population parameters, confidence intervals, and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD), and relative weight (Wr) based on length categories. Abundance was expressed as the mean CPUE (mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

RESULTS AND DISCUSSION

Stockade Lake receives a high amount of fishing pressure from area residents as well as nonresidents because of its location in Custer State Park. Largemouth bass, smallmouth bass, brown trout, yellow perch, and black crappie are the primary species in this lake. Rainbow trout, black bullheads, golden shiners, northern pike, and white suckers are secondary species in Stockade. A 15-inch (381 mm) minimum length limit for largemouth bass was established in 1995 in hopes of improving bass and panfish population structures. Smallmouth bass were added to the minimum length limit in 2004.

Six different species of fish were caught in gill nets (Table 2). Species collected were (in order of abundance) yellow perch, northern pike, smallmouth bass, white sucker, black crappie, and largemouth bass. Seven species of fish were caught in trap nets (Table 3). Night boat electrofishing was conducted in the spring to sample brown trout. Only 1 was caught, which came from the second stocking of browns (Table 4).

Table 2. Total catch for two 150-ft. experimental, sinking, monofilament gill nets in Stockade Reservoir, Custer County, South Dakota on 7-8 September 2006. Total number, CPUE (80% CI), CPUE-stock (80% CI), PSD, RSD-P (90% CI), and Wr-stock (90% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Black crappie	9	4.5 (10.8)	4.0 (9.2)	0	0	109 (6)
Largemouth bass	1	0.5 (1.5)	0.5 (1.5)	100	100	130
Northern pike	22	11.0 (3.1)	11.0 (3.1)	18 (15)	0	103 (2)
Smallmouth bass	10	5.0 (6.1)	5.0 (6.1)	100 (0)	100 (0)	109 (2)
White sucker	9	4.5 (4.6)	4.5 (4.6)	100 (0)	100 (0)	106 (2)
Yellow perch	100	50.0 (18.5)	34.5 (4.6)	48 (10)	23 (9)	91 (1)
Total	**151**					

Table 3. Total catch of 8 overnight trap net sets in Stockade Reservoir, Custer County, South Dakota on 7-8 September 2006. Total number, CPUE (80% CI), CPUE-stock (80% CI), PSD, RSD-P (90% CI), and Wr-stock (80% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Black bullhead	1	0.1 (0.2)	0.1 (0.2)	100	0	103
Black crappie	44	5.5 (2.9)	5.3 (2.8)	74 (11)	40 (13)	102 (1)
Largemouth bass	4	0.5 (0.5)	0	0	0	na
Northern pike	12	1.5 (1.3)	1.3 (1.3)	70 (28)	20 (24)	99
Smallmouth bass	5	0.6 (0.6)	0.5 (0.5)	50 (50)	25 (59)	111 (18)
White sucker	26	3.3 (1.5)	3.3 (1.5)	100 (0)	100 (0)	96 (2)
Yellow perch	97	12.1 (5.0)	12.0 (5.0)	66 (8)	18 (6)	na
Total	**189**					

Table 4. Total catch of 6 ten-minute night electrofishing passes on Stockade Reservoir, Custer County, South Dakota on 8 May 2006. Total number, CPUE (80% CI), CPUE-Stock (80% CI), PSD, RSD-P (90% CI), and Wr-Stock (80% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Hatchery brown trout	1	1.0	-	-	-	137
Total	**1**					

Yellow perch

The PSD, RSD-P, Wr, and CPUE-S for yellow perch in Stockade Reservoir had been increasing since 2003. The PSD, Wr, and CPUE-S all decreased this year (Figure 5). However, the RSD-P increased to 23, which is excellent. Yellow perch growth was nearly identical to calculated growth of 2005 (Figure 6). Perch were growing to a quality length of 200 mm (8 in) at 4 years of age, which is slightly faster than in previous years and slower than the SD mean. The length frequency histogram for 2005 showed a lack of smaller perch, but the 2006 graph showed a large year class of smaller perch (Figure 7). A large number of stock to quality length perch were absent compared to previous years.

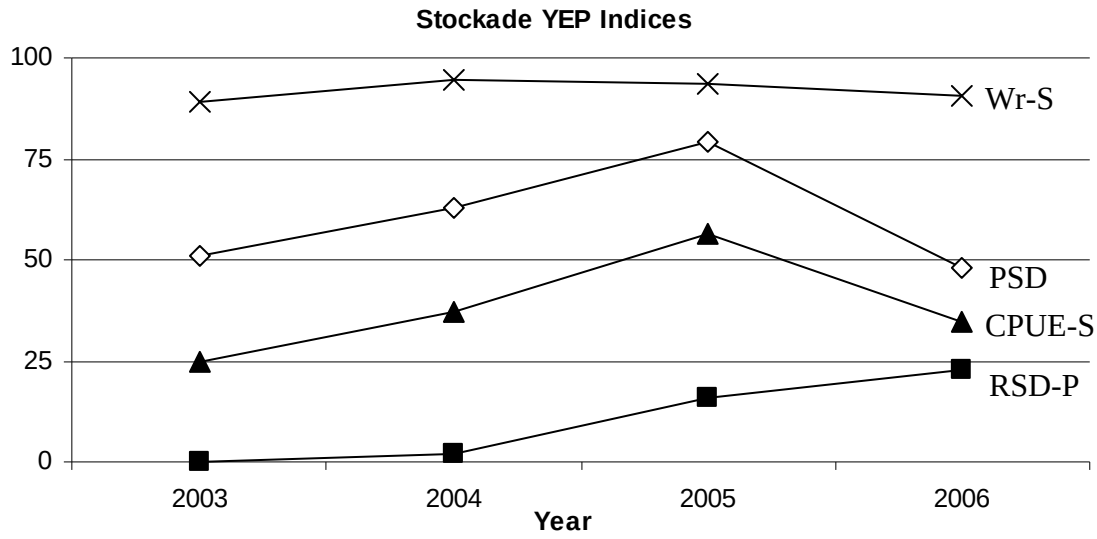


Figure 5. Stock density indices, CPUE, and Wr's for yellow perch captured in gill nets at Stockade Reservoir, Custer County, South Dakota.

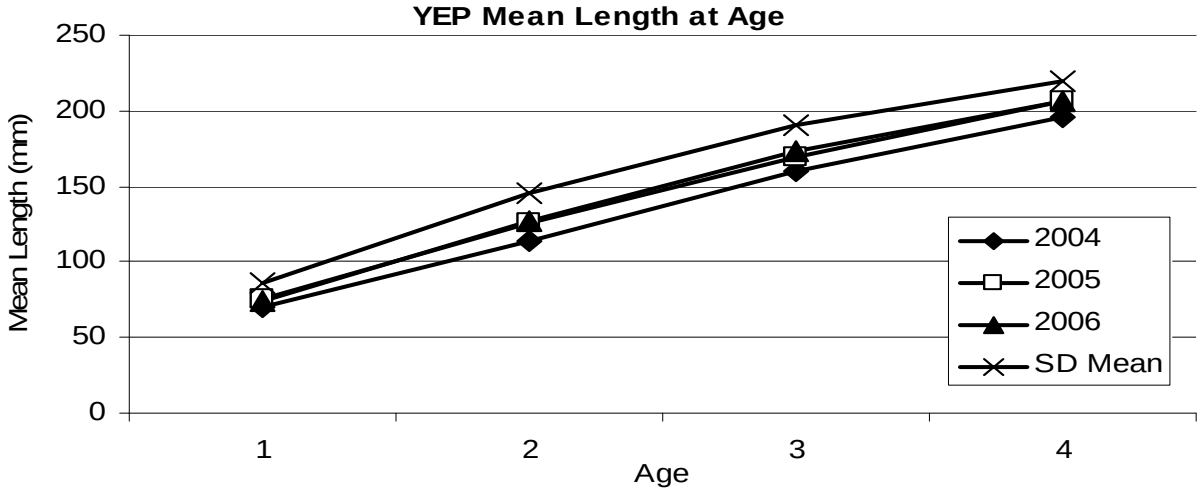


Figure 6. Mean back-calculated length at age for yellow perch from Stockade Reservoir, Custer County, South Dakota. The SD mean is from Willis et al. 1990.

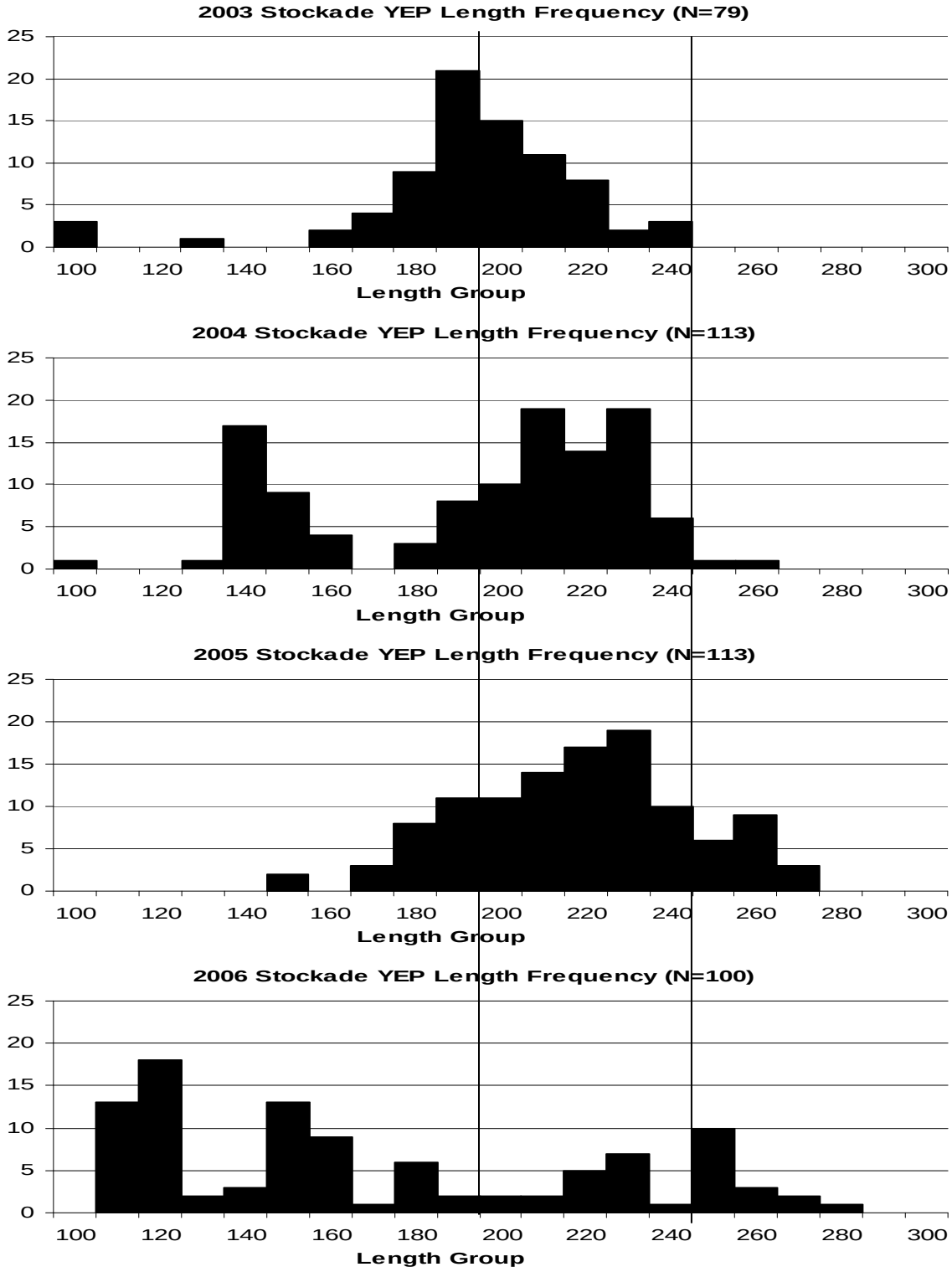


Figure 7. Length frequency histograms for yellow perch collected by gill nets in Stockade Reservoir, Custer County, South Dakota. The solid lines represent quality and preferred lengths (8 and 10 in, respectively).

Black crappie

CPUE-S and RSD-P values increased in 2006, however, PSD decreased (Figure 8). Catch rates had been steadily declining, but increased this year. We sampled 44 crappies in trap nets. A high number of larger crappies were observed on the length frequency histogram this year (Figure 10). Condition remained excellent, indicated by Wr values again above 100 and growth was approaching statewide means for black crappie in 2006 (Figure 9).

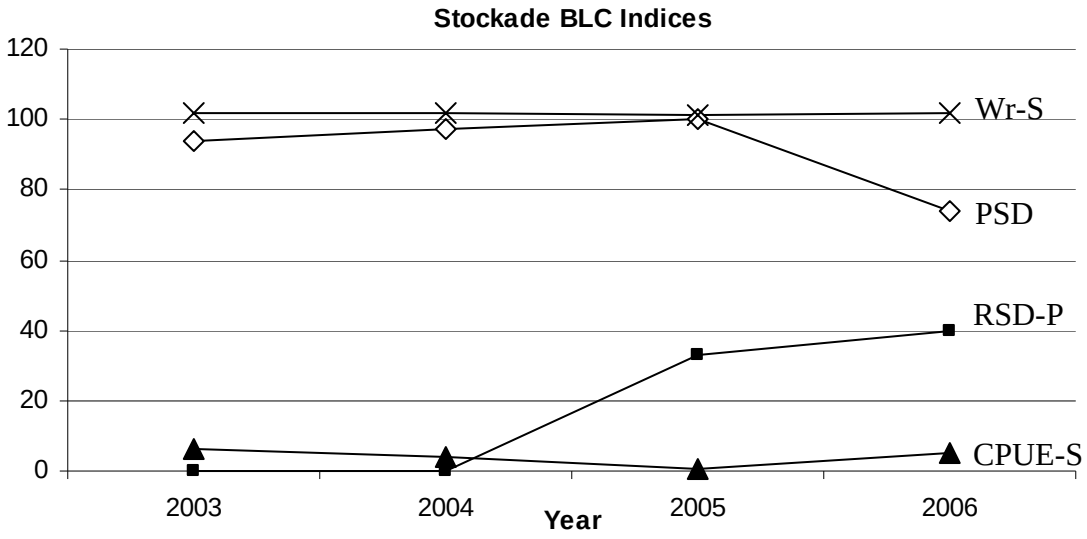


Figure 8. Stock density indices, CPUE, and Wr for black crappie captured in trap nets at Stockade Reservoir, Custer County, South Dakota.

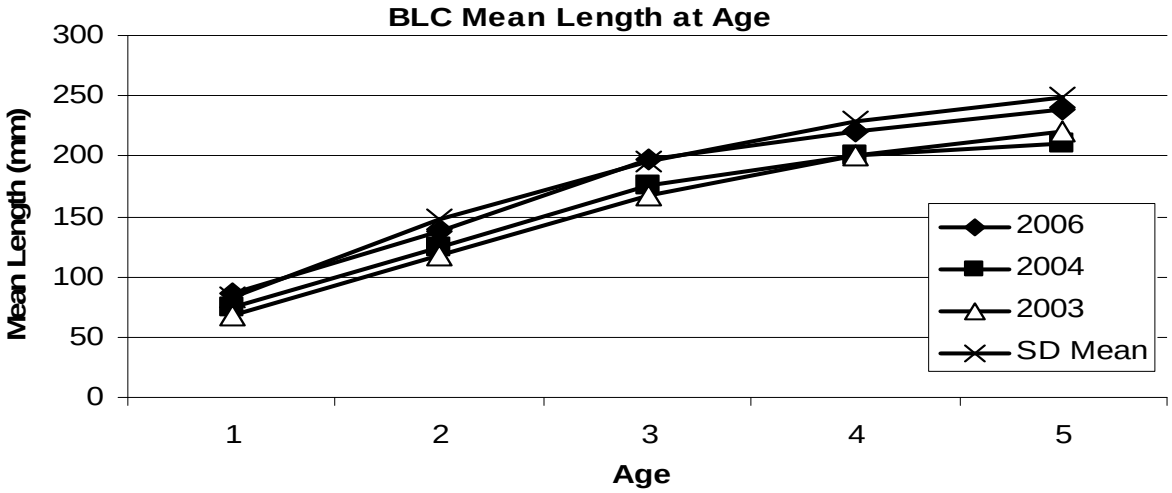


Figure 9. Mean back-calculated length at age for black crappie from Stockade Reservoir, Custer County, South Dakota. The SD mean is from Willis et al. 1990.

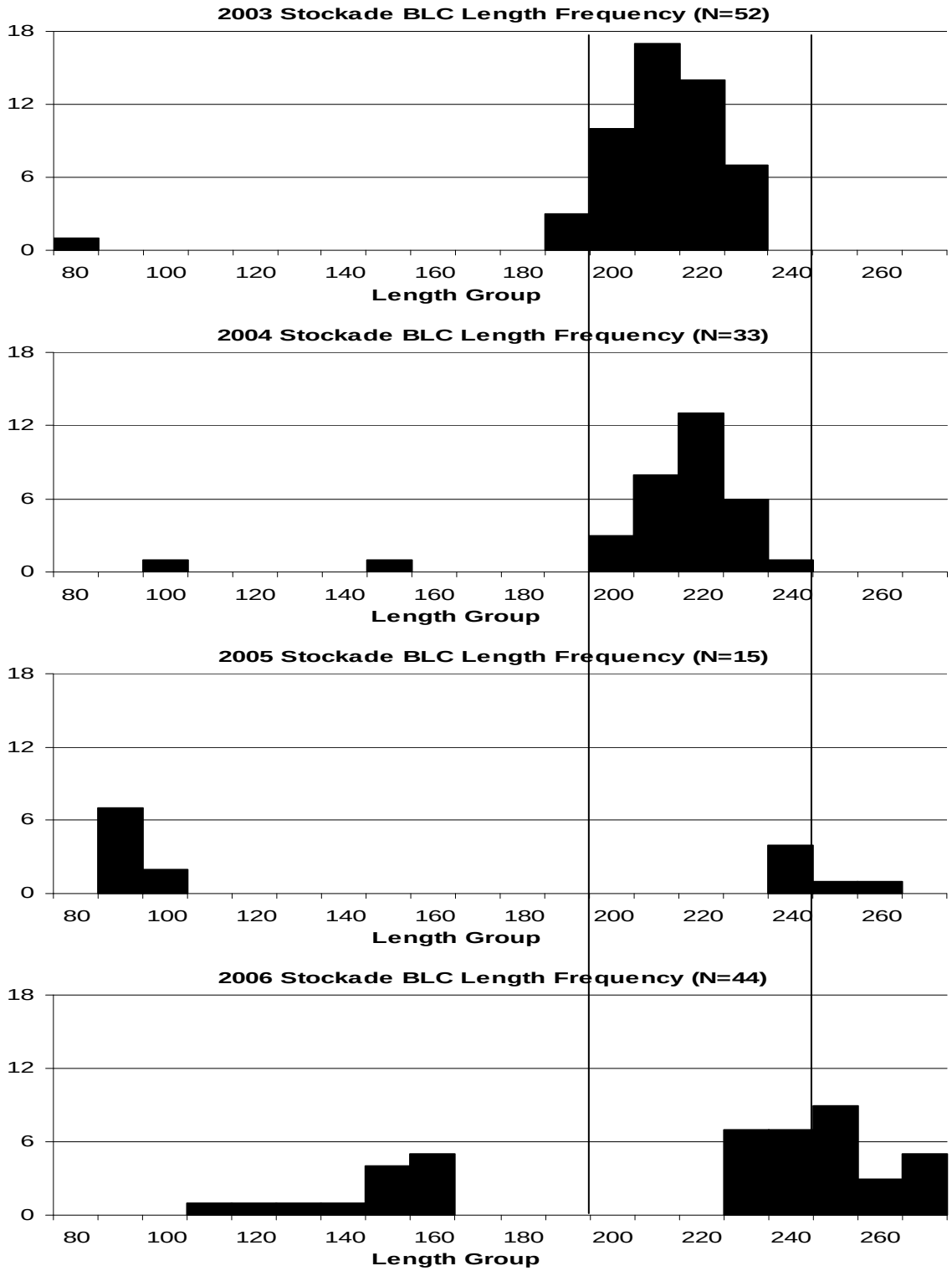


Figure 10. Length frequency histograms for black crappie collected in trap nets at Stockade Reservoir, Custer County, South Dakota. The solid lines represent quality and preferred lengths (8 and 10 in, respectively).

Brown trout

In 2004 and 2005, 3,250 catchable brown trout were stocked into Stockade Reservoir. During the 2004 sampling period, 8 brown trout were caught, in 2005 only 2 were caught, and in 2006 only 1 (Figure 11). No browns from the 2005 stocking were sampled.

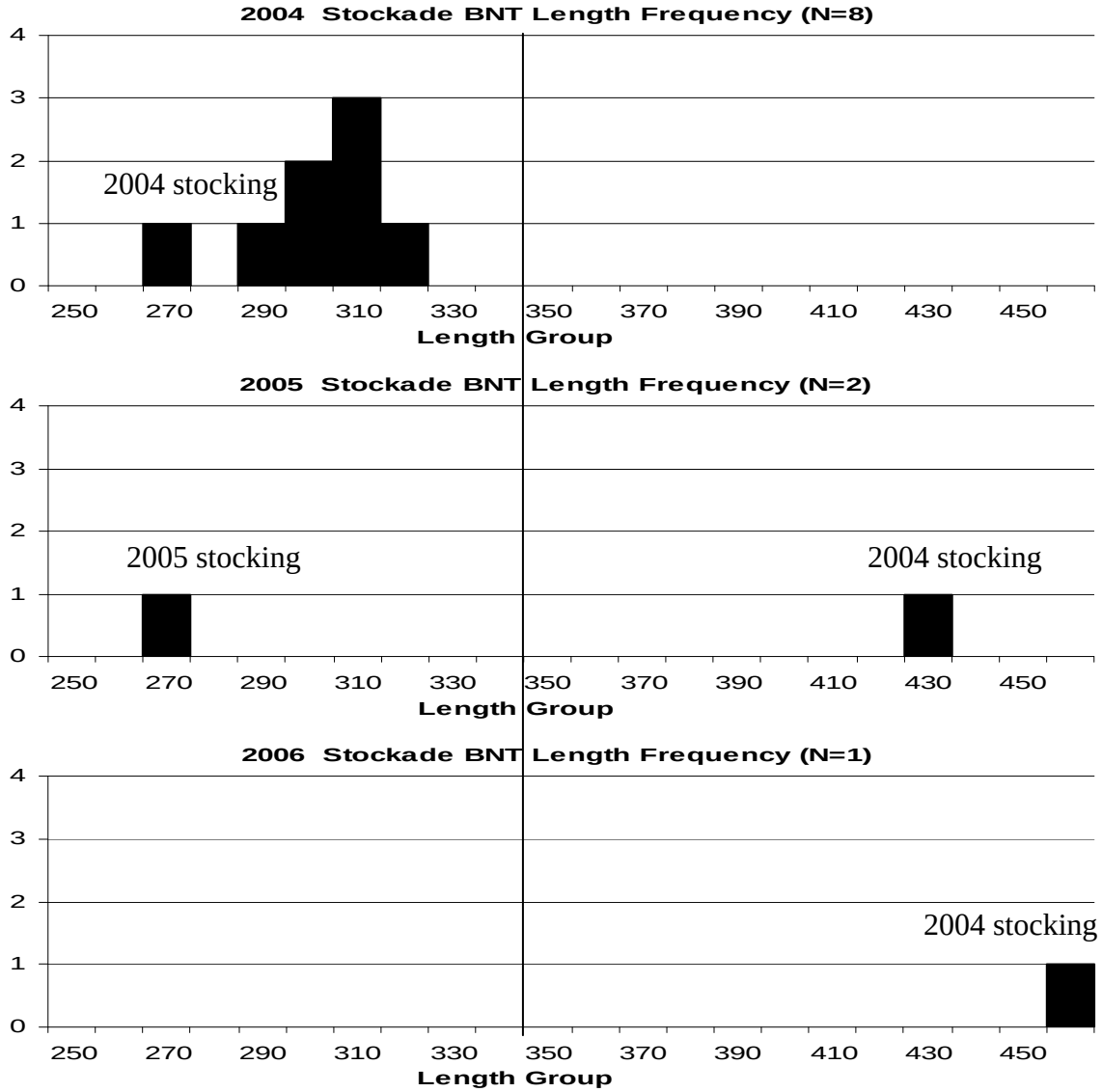


Figure 11. Length frequency histogram for brown trout collected in gill nets and by electroshocking at Stockade Reservoir, Custer County, South Dakota. The solid line indicates 14 inches.

RECOMMENDATIONS

1. Conduct a night electrofishing survey for smallmouth and largemouth bass in the spring of 2007.

2. Conduct gill and trap netting during the late summer of 2007.

3. Discontinue brown trout stocking at Stockade.

REFERENCES

Carlander, K.D. 1977. Handbook of Freshwater Fishery Biology, Volume2. Iowa State University Press, Ames, Iowa.

Francis, J. 1999. WinFin, Version 3.42; Microsoft Access Program for data entry. Nebraska Game and Fish Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.7. Nebraska Game and Fish Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorensen, and E.G. Unkenholz. 1990. Growth of South Dakota fishes: a statewide summary with means by region and water type. Special Report. South Dakota Game, Fish, and Parks. Pierre, South Dakota.

APPENDIX

Appendix 1. Stocking record for Stockade Reservoir, Custer County, South Dakota from 1990 through 2006.

Species	Year	Number	Size
Brown trout	2004	3,250	catchable
	2005	3,250	catchable
Cutthroat trout	1991	17,707	medium fingerling
Rainbow trout	1990	83,022	fingerling
	1991	82,557	medium fingerling
		150	large fingerling
	1992	14,525	medium fingerling
		78,975	small fingerling
	1993	70,000	medium fingerling
	1994	70,000	medium fingerling
(Kamloop strain)	1995	70,000	fingerling
(Kamloop strain)	1996	70,000	fingerling (200/kg)
(Growth strain)	1997	70,000	fingerling (200/kg)
	1998	67,700	fingerling
		70	adult
	1999	77,580	fingerling
	2000	10	adult
	2001	69,844	fingerling
	2002	30,000	fingerling
		1,194	catchable
	2004	50	adult
Smallmouth bass	1990	14,750	fingerling
	1991	13,000	medium fingerling
	1992	13,000	medium fingerling
	1993	13,000	medium fingerling
Largemouth bass	2003	409	adult

No stocking was done in 1988 or 1989 due to drawdown of lake for silt removal, spillway repair, and work on the water level control valve.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Angostura Reservoir County: Fall River
Legal description: T 8S, R 5,6 E Sec. 1-12,17,19, 20, 21, 28-33
Location from nearest town: 7 miles southeast of Hot Springs, SD.
Dates of present survey: August 4, 14-16, 2006
Date last surveyed: July 28, August 15-17, 2005
Most recent lake management plan: F21-R-30 Date: 1998
Management classification: Warmwater permanent Contour mapped: 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Bluegill
2. Channel catfish	2. Common carp
3. Smallmouth bass	3. Green sunfish
4. Gizzard shad	4. Northern pike
5. Largemouth bass	5. Northern redhorse
6. Black crappie	6. River carpsucker
7. Spottail shiner	7. White sucker
8. Emerald shiner	8. Yellow perch

PHYSICAL CHARACTERISTICS

Surface Area: 4,612 acres; Watershed: 5,824,000 acres
Maximum depth: 70 feet; Mean depth: 29.3 feet
Lake elevation at survey (from known benchmark): unknown

1. Describe ownership of lake and adjacent lakeshore property:

The U.S. Bureau of Reclamation performs the maintenance of Angostura Reservoir and Dam. The South Dakota Department of Game, Fish and Parks manages much of the adjacent land as a recreation/campground area and game production area. The local irrigation district controls the water level and irrigation releases.

2. Describe watershed condition and percentages of land use:

The Angostura Reservoir watershed consists of approximately 9,100 square miles of livestock pastureland. Ownership of the watershed is predominately private with a small portion in Buffalo Gap National Grassland.

3. Describe aquatic vegetative condition:

Little precipitation throughout 2006 along with heavy irrigation left Angostura with low water levels. Emergent vegetation was left high and dry. Submergent vegetation, mostly Curlyleaf

pondweed *Potamogeton crispus*, was observed in the bays and shallow water areas of Angostura during the 2006 lake survey.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

No apparent problems were identified on either the dam or spillway. Most of the boat ramps and other facilities were in good condition, though low water levels had all but one ramp unusable by late summer. The deep water ramp on the north side of the lake was extended in 2006 to allow for better boating access.

CHEMICAL DATA

1.Describe general water quality characteristics:

Dissolved oxygen was good at 5.4mg/l at 42 feet and pH was somewhat basic but within tolerable levels for fish.

2. Thermocline: **N/A**

Temperatures remained fairly stable down to 42 feet.

3. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted on Angostura Reservoir August 14-16, 2006. Sampling consisted of 4 gill net nights and 8 trap net nights (Appendix C). All gill nets were monofilament experimental 150 foot nets. The switch from 300 foot gill nets was to get better confidence in our catch rate data. The gill net was a monofilament experimental net 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at eight stations consisting of 1 trap net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (¾-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE; number of fish collected per net night or number of fish collected per hour of electrofishing), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr for stock length and larger fish.

Results and Discussion

Age-0 Fish Survey

Day electrofishing was added in 2004 in attempt to increase our understanding and sample sizes concerning shad reproduction. Ten sampling runs were accomplished during August 4, 2006 (Table 1). Three runs were completed in the Horsehead area, 3 runs in the Cheyenne Arm, 2 runs in the Sheps Canyon area near the dam, and 2 runs in the middle of the reservoir (Mid Zones). A total of 381 young of the year gizzard shad were captured in 0.92 hours of electrofishing and nine of the ten sites sampled had shad indicating good reproduction in 2006. In 2005, a total of 293 young shad were captured in 0.92 hours of electrofishing with nine of the ten sites having shad.

Table 1. Daytime electrofishing results from Angostura Reservoir, August 4, 2006.

Site	No./Site	Time (sec)	No./hr
1	29	300	348
2	57	300	684
3	0	600	0
4	109	300	1308
5	19	300	228
6	89	300	1068
7	3	300	36
8	23	300	276
9	10	300	120
10	42	300	504
Total	**381**	**0.92 hours**	**414.1**

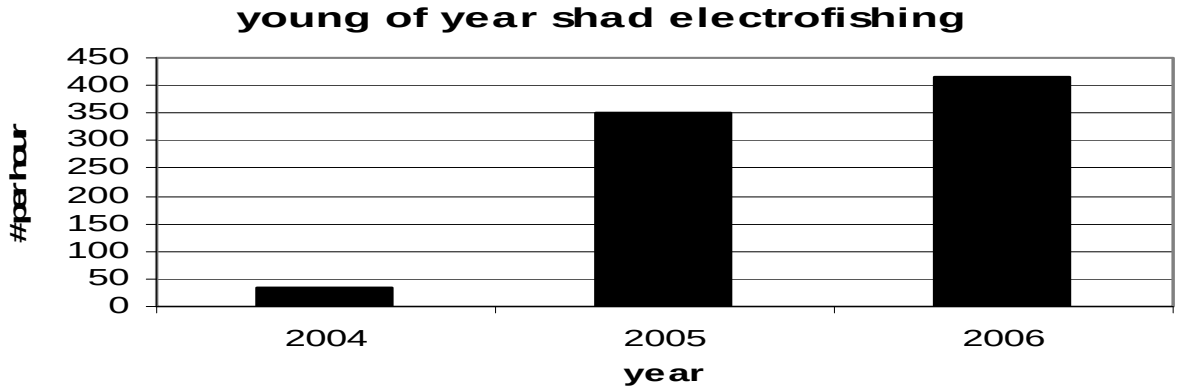


Figure 1. Daytime electrofishing results for young of year gizzard shad from 10 sites in Angostura 2004-2006.

Fish Community Survey

Twelve species were collected in both gill nets and trap nets during the 2005 lake survey of Angostura Reservoir. Eleven species, totaling 360 fish, were collected in four experimental gill nets (Table 2). Channel catfish (47.2%) were the most common species collected with walleye (27.2%) being the second most common. Other species collected in the gillnets were black crappie, common carp, freshwater drum, gizzard shad, river carpsucker, shorthead redhorse, smallmouth bass, spottail shiner, and yellow perch.

Six species, totaling 92 fish, were collected in trap nets during the 2006 survey. Black crappie (43.5%) were the most common fish collected and channel catfish (33.7%) the second most common (Table 3). Other species collected were bluegill, freshwater drum, river carpsucker, and walleye.

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from four, 150-ft experimental sinking gill nets in Angostura Reservoir, Fall River County, August 14-16, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	11	2.8(4.5)	2.0(3.3)	0(--)	0(--)	99.1(9.6)
Channel catfish	170	42.5(12.3)	14.3(4.2)	5(5)	0(--)	75.2(1.0)
Common carp	11	2.8(1.6)	2.5(1.4)	40(30)	10(18)	84.7(3.4)
Freshwater drum	23	5.8(1.6)	5.0(1.3)	5(9)	0(--)	86.2(0.9)
Gizzard shad	4	1.0(1.2)	----	0(--)	0(--)	--
River carpsucker	33	8.3(3.2)	8.3(3.2)	100(--)	94(7)	90.6(1.5)
Shorthead redhorse	3	0.8(0.4)	0.8(0.4)	100(--)	100(--)	74.3(11.3)
Smallmouth bass	1	0.3(0.4)	0.3(0.4)	--	--	101.6
Spottail shiner	1	0.3(0.4)	----	--	--	--
Walleye	98	24.5(6.8)	23.3(6.0)	27(8)	3(3)	82.8(0.1)
Yellow perch	5	1.3(1.6)	1.3(1.6)	60(52)	--	78.2(3.7)
Totals	360					

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Angostura Reservoir, Fall River County, August 14-16, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	40	5.0(1.9)	4.0(1.6)	19(12)	6(8)	101.0(0.6)
Bluegill	1	0.1(0.2)	0.1(0.2)	--	--	93.7(--)
Channel catfish	31	3.9(1.5)	----	--	--	--
Freshwater drum	1	0.1(0.2)	----	--	--	93.5(--)
River carpsucker	10	1.3(1.1)	0.1(0.2)	--	--	84.0(--)
Walleye	9	1.1(0.4)	1.0(0.4)	75(31)	75(31)	76.9(3.3)
Totals	92					

Black crappies

Black crappie abundance decreased from last year with a frame net CPUE of 5.0 (Table 4). It should be noted that trap nets could not be set in normal locations because of very low water. PSD was lower at 19 while RSD-P stayed the same at 6. Mean condition of frame net black crappie greater than stock length was good with a Wr of 101 (Table 3). The length frequency

histogram for 2006 shows a good number of age one fish in the 130 to 140 millimeter range (Figure 2). Growth was excellent as shown in table 5.

Table 4. Composite listing of sample size (N), catch per unit effort (CPUE; 80% confidence intervals are given in parentheses), catch per unit effort of stock length fish (CPUE-S; 80% CI's are given in parentheses), and proportional stock densities (PSD, RSD; 90% CI's are given in parentheses) for black crappie collected by trap nets in Angostura Reservoir, 2001-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P
2001	22	1.8 (1.7)	1.6 (1.6)	79 (17)	63 (20)
2002	33	3.0 (1.3)	1.9 (1.0)	52 (20)	29 (18)
2003	30	2.7 (0.9)	2.0 (0.7)	55 (19)	14 (13)
2004	15	1.9 (1.6)	0.6 (0.5)	40 (52)	20 (43)
2005	87	10.9 (7.5)	10.5 (7.3)	69 (8)	6 (4)
2006	40	5.0 (1.9)	4.0 (1.6)	19 (12)	6 (8)

Table 5. Angostura Reservoir black crappie year class, age in 2006, sample size (N), mean back-calculated total length-at-age, population standard error (SE).

Year Class	Age	N	Age 1	Age 2	Age 3
2005	1	22	63		
2004	2	5	70	160	
2003	3	2	91	164	244
Mean (SE)		**29**	**75(8)**	**162(2)**	**244(0)**
Region 1			74 (3)	122 (7)	158 (9)
SD mean			83 (2)	147 (4)	195 (5)

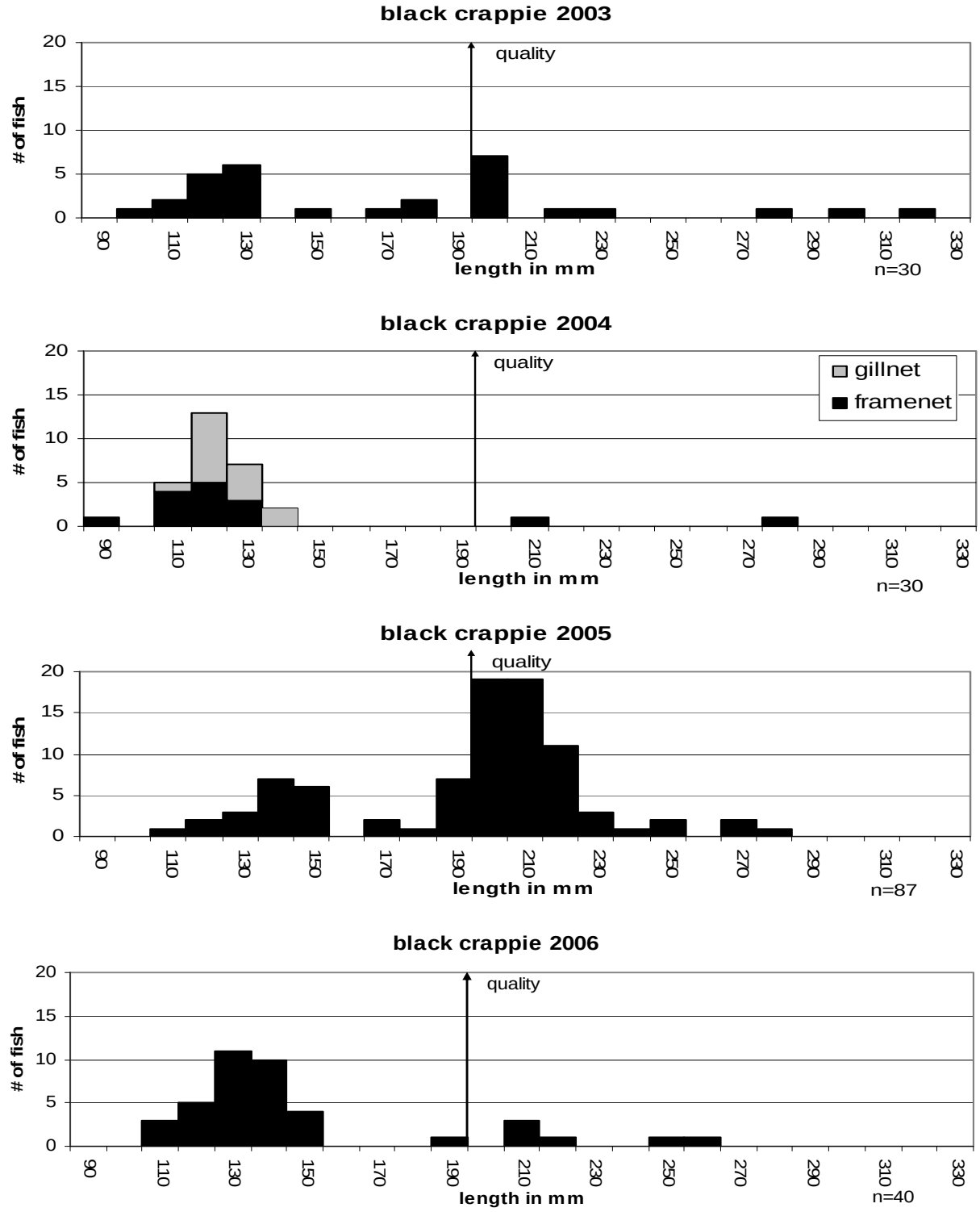


Figure 2. Length histogram of black crappies collected in trap nets from Angostura Reservoir, Fall River County 2003-2006.

Channel Catfish

Channel catfish were the most abundant fish collected in gill nets and trap nets (Tables 2 and 3). Gill net mean CPUE for all catfish was 42.5, and for fish stock length and greater the mean CPUE was 14.3 (Table 5). If you double these numbers, CPUE would be nearly identical to last year with the 300 foot gill nets. Stock density indices remain very low; PSD=5, RSD-P=0. Mean Wr for stock length and larger catfish dipped to 75.2 (Table 3).The length frequency histogram (Figure 3) shows few catfish over 310 mm. There appears to be a large year class stalled out at around 240mm, which has moved very little over the past four years.

During the springs of 2004-2006, Angostura was used as a source for channel catfish and small adult catfish were removed and stocked into other South Dakota waters. Plans are to continue using this reservoir as a stocking source for other waters over the next couple of years. Whether or not the removals will have an affect on size structure and density of the population remains to be seen.

Table 5. Composite listing of sample size (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80% CI's in parentheses) and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for channel catfish collected by gillnets in Angostura Reservoir, 1997-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P
1997	89	29.7 (35.9)	14.0 (14.6)	22 (6)	1 (1)
1998	52	17.3 (16.6)	10.4 (11.0)	10 (5)	2 (3)
2000	483	96.6 (33.1)	50.8 (17.1)	20 (4)	3 (2)
2001	339	67.8 (49.2)	31.4 (26.3)	20 (6)	2 (2)
2002	351	87.8 (29.8)	15.5 (17.8)	3 (4)	0 (--)
2003	233	58.3 (26.4)	16.5 (6.0)	8 (6)	0 (--)
2004	462	115.5 (51.7)	38.0 (17.2)	14 (5)	0 (--)
2005	171	85.5 (97.0)	21.5 (10.8)	5 (5)	0 (--)
2006*	170	42.5(12.3)	14.3(4.2)	5(5)	0(--)

*150 foot gillnets instead of 300 footers pre-2006.

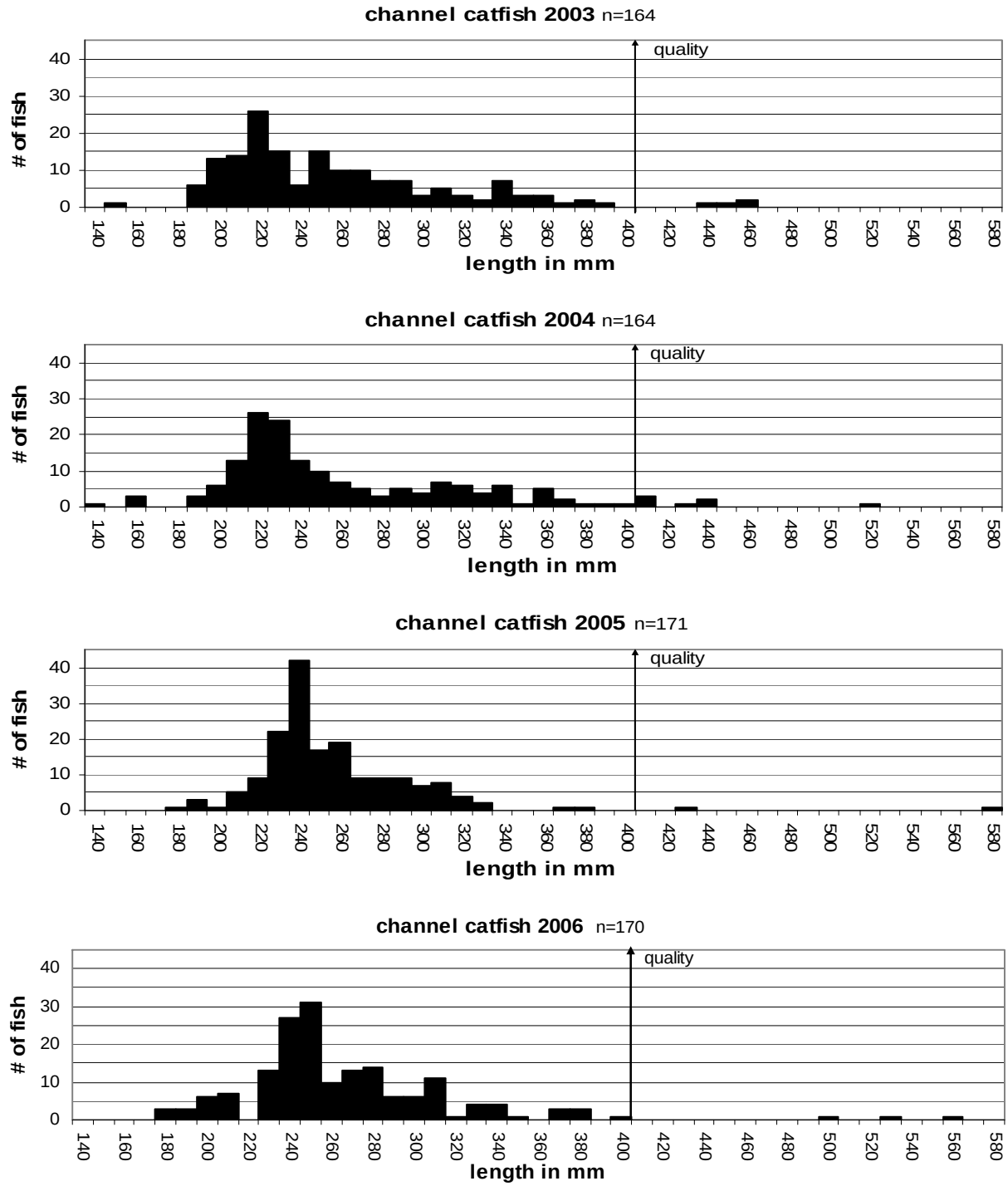


Figure 3. Length frequency histogram of channel catfish collected in gill nets from Angostura Reservoir, Fall River County, 2002-2006.

Gizzard shad

Gizzard shad were introduced to Angostura Reservoir in 1990 to provide forage for game fish, especially walleye, which were experiencing slow growth, poor condition and high mortality. The first age-0 gizzard shad were collected in 1994 during the ¼ arc seine survey. No adult gizzard shad have been stocked in Angostura Reservoir since 1994. Gill net CPUE for shad ≥stock length was 0.0, this is down slightly from the last year which had CPUE's of 2.0. A total of 381 young of the year gizzard shad were captured in 0.92 hours of electrofishing and nine of the ten sites sampled had shad indicating good reproduction in 2006. This is the most fish sampled in the three year history of daytime electrofishing (Figure 1)

The northern latitude of South Dakota and subsequent cold winter water temperatures most likely causes some over-winter mortality of gizzard shad on an annual basis. Limited winter mortality of gizzard shad is desirable to keep densities of adult shad low while maintaining a high reproductive potential. Due to the continued presence of age-0 shad and adults during annual gill net sampling, it is apparent that some survival of adult shad is occurring and the surviving adult shad can produce large year classes of juveniles.

Walleye

Angostura remains one of the most popular walleye fisheries in western South Dakota. Even with high fishing pressure, walleye abundance remains good with a gill net CPUE of 24.5 (Table 3). Last year, CPUE was higher at 81.0, this was with 300 foot gill nets and confidence levels were extremely high. CPUE, for stock length and larger fish, showed a similar pattern with a CPUE of 23.3 compared to 54.5 last year. The 2005 lake management plan sets the target walleye CPUE to be at least 20 per gillnet, which was achieved in 2006.

Stock density indices indicate a smaller proportion of quality walleye to last year. In 2004, PSD was 57, compared to a PSD value of 56 last year (Table 12). This year it was down to 27, which shows the population may be becoming out of balance, being dominated by small fish. The current management plans goal is a PSD between 30 and 60. This the first time since 1994 that the PSD has dropped below thirty, when the large year class in the 10 to 12 inch range reaches quality next year, PSD should rebound. RSD-P also decreased to three which is down from 11 last year. In efforts to decrease the pressure on larger walleye, a one over 20 inch regulation was added to the 14 inch minimum. It is questionable if this regulation will have a major impact on our percentage of fish over preferred-length, since only three percent of the population is making it to 20 inches but creel data has showed that anglers target this segment of the population. At the very least this regulation will socially place a higher value on these larger walleye.

Walleye condition declined from last year when stock-length and larger walleye averaged 86.1. During this survey, fish condition has fallen to 82.8. Growth remains excellent with fish averaging over 16 inches by age 4 which is well above the state average (Table 7), and beyond management objectives.

Table 6. Composite listing of sample size (N), catch per unit effort (CPUE; standard error is given in parentheses), mean total length (TL; standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for walleye collected by gill net in Angostura Reservoir, 1992-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
1992		7.5		65	20	
1993	101	6.3		25	8	
1994		11		18	4	
1995	17	1.9		59	29	
1996	15	1.3		93	47	
1997	51	5.7		48	10	
1998	52	5.8		60	6	
2000	249	49.8 (15.5)	39.4 (14.2)	43 (6)	7 (3)	87.8 (0.5)
2001	87	17.4 (11.7)	15.4 (10.9)	31 (9)	8 (5)	87.3 (1.3)
2002	135	33.8 (19.2)	28.3 (19.4)	50 (8)	4 (3)	85.7 (0.0)
2003	117	29.3 (26.2)	23.3 (19.7)	32 (8)	2 (3)	84.6 (0.2)
2004	137	34.3 (14.1)	30.3 (13.0)	57 (8)	6 (4)	82.2 (0.4)
2005	162	81.0 (153.9)	54.5 (100.0)	56 (8)	11 (5)	86.1 (0.6)
2006	98	*24.5 (6.8)	*23.3 (6.0)	27 (8)	3 (3)	82.8 (0.1)

*150 foot gillnets instead of 300 footers pre-2006.

Table 7. Angostura Reservoir walleye year class, age in 2006, sample size (N), mean back-calculated total length-at-age, population standard error (SE), the Region 1 and South Dakota walleye mean length-at-ages (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2005	1	61	227				
2004	2	14	180	332			
2003	3	7	172	280	381		
2002	4	4	184	295	382	421	
2001	5	9	194	315	399	438	467
Mean (SE)			**192(10)**	**305(11)**	**387(6)**	**430(9)**	**467(0)**
Region 1			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)
S.D. Mean			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)

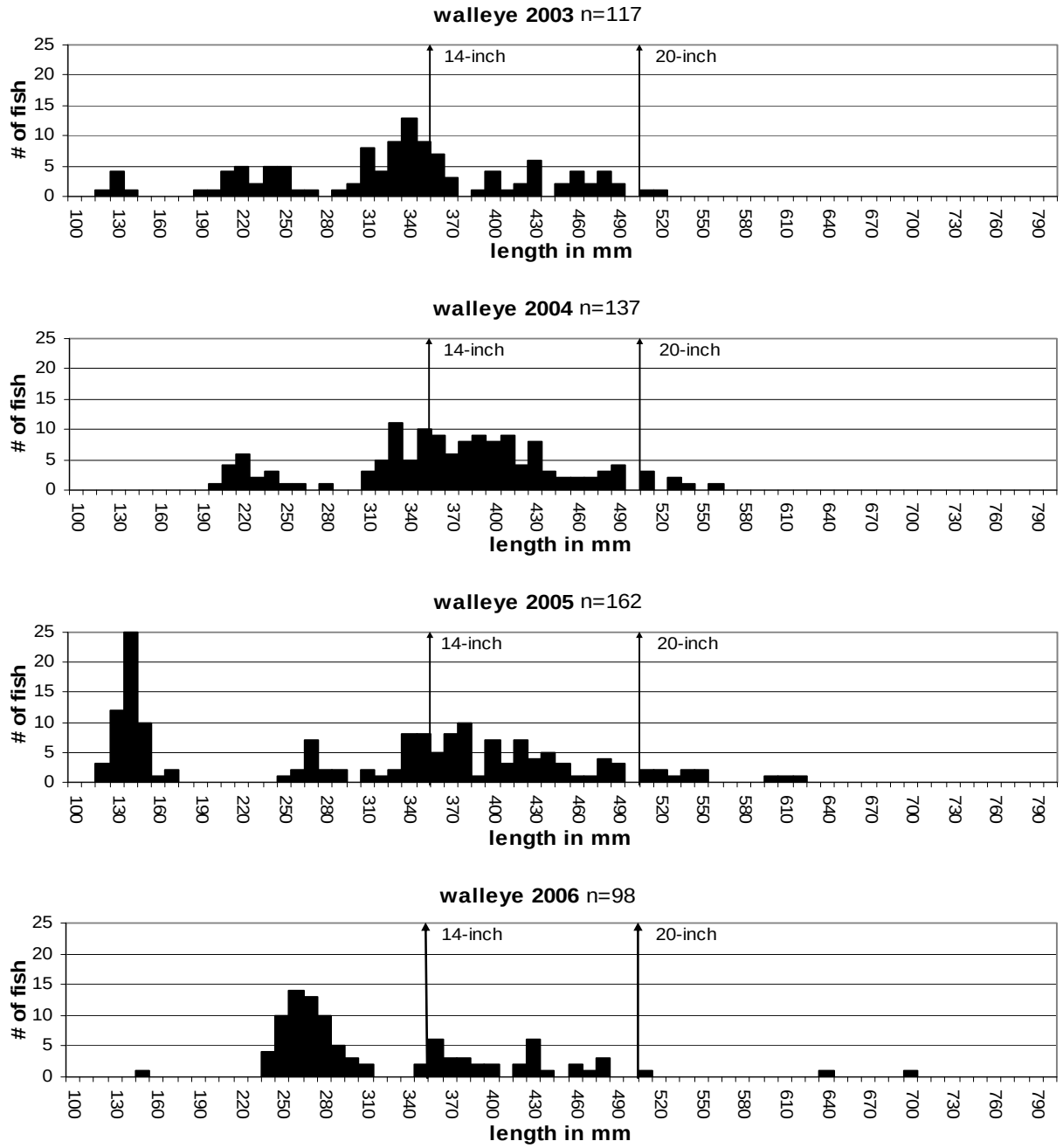


Figure 4. Length frequency histograms for walleye collected in gill nets at Angostura Reservoir, Fall River County, 2002-2006.

Yellow perch

Angostura's perch population remains low. This is probably due to high predator abundance and poor perch habitat. Gill net CPUE was 1.3 with 150 foot gill nets, compared to 2005's CPUE at 6.0 with 300 foot gill nets. Perch condition was low for Angostura with a mean Wr for stock length and larger fish of 78.2, compared to 85.3 last year. Due to small sample size, age and growth analysis was not completed.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., B.R. Murphy, and C.S. Guy. 1993. Stock density indices: development, use, and limitations. Reviews in Fisheries Science 1(3):203-222.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting annual lake surveys to evaluate fish populations and regulation success.

2. Closely watch size structure, as PSD fell below management objectives for walleye. Different regulations may be required to reach management objectives because of high angling harvest.

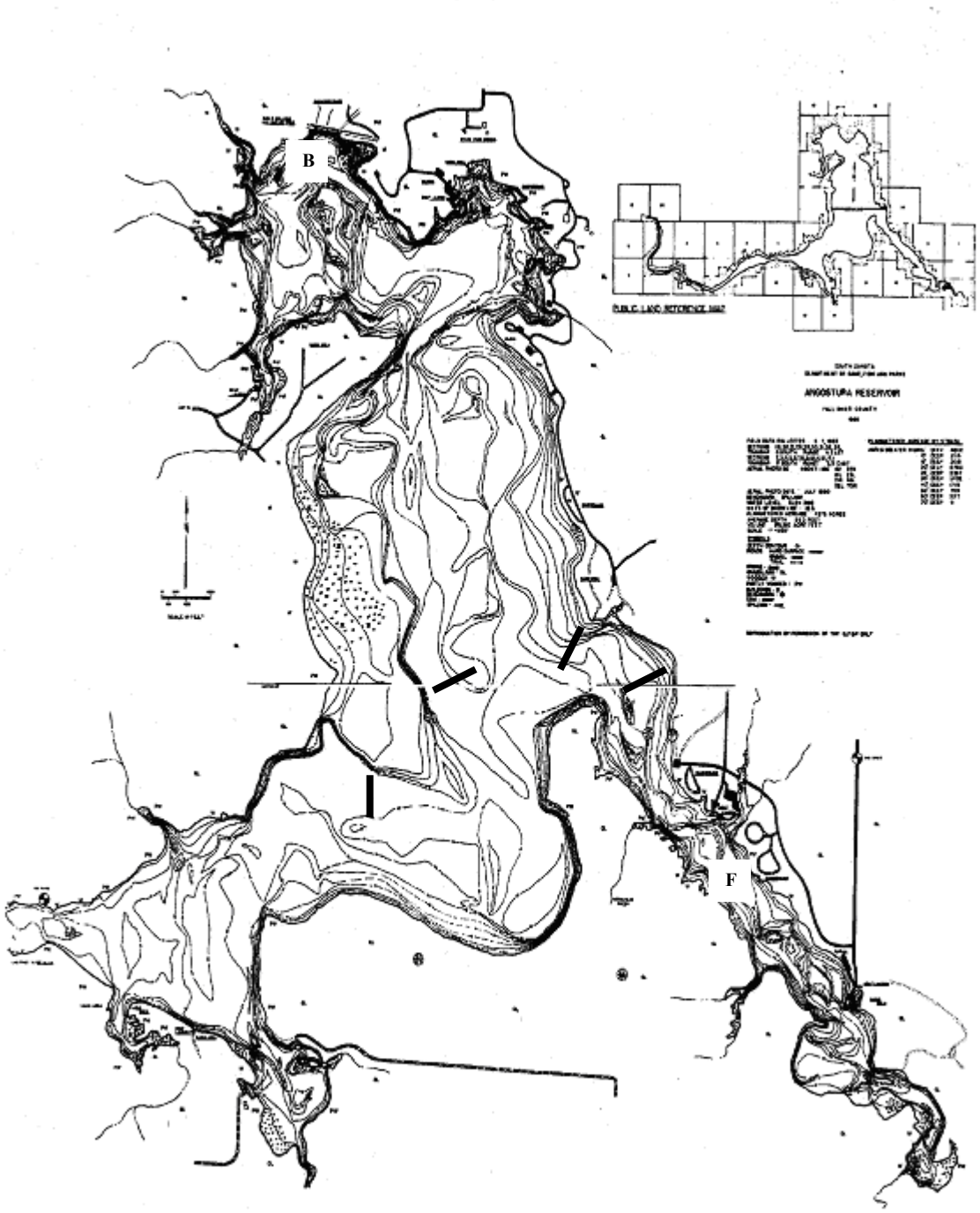
APPENDICES

Appendix A. Stocking record for Angostura Reservoir, Fall River County, 1990-2006.

Year	Number	Species	Size
1992	300	Gizzard shad	Adult
	235,000	Walleye	Fingerling
1993	150,000	Largemouth bass	Fingerling
	235,000	Walleye	Fingerling
1994	43	Gizzard shad	Adult
	67,870	Largemouth bass	Fingerling
1995	100,000	Largemouth bass	Fingerling
	204,555	Walleye	Fingerling
1996	135,387	Largemouth bass	Fingerling
	354,070	Walleye	Fingerling
1998	109,962	Largemouth bass	Fingerling
	201,084	Walleye	Fingerling
1999	15	Gizzard shad	Adult
	48,000	Largemouth bass	Fingerling
	248,280	Walleye	Fingerling
2000	97,133	Rainbow trout	Fingerling
	207,779	Walleye	Fingerling
2001	12,638	Largemouth bass	Fingerling
	37,000	Rainbow trout	Fingerling
2002	50,100	Walleye	Fingerling
	30,000	Smallmouth bass	Fingerling
2003	218,791	Walleye	Fingerling
	80,000	Rainbow trout	Fingerling
2005	381,045	Walleye	Fingerling

Appendix B. Water chemistry results from on Angostura Reservoir, August 29, 2006.

Site	Depth (ft)	Temp (^{o}C)	D.O. (mg/l)	pH
A	surface	21.6	9.3	7.7
	2.0	21.8	8.3	8.3
	4.7	21.7	8.2	8.3
	7.8	21.6	8.0	8.3
	11.0	21.6	7.8	8.3
	14.1	21.6	7.7	8.3
	18.5	21.5	7.6	8.3
	21.6	21.5	7.5	8.3
	25.9	21.5	7.2	8.3
	29.5	21.4	6.8	8.3
	34.3	21.3	6.6	8.3
	38.3	21.3	6.4	8.3
	42.1	21.2	5.4	8.2



B -Water chemistry sites

-Gill net locations

F -Frame net station

Appendix C. Map of Angostura Reservoir and sampling sites.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Cottonwood Springs Dam County: Fall River
Legal description: Sec 18, T 7 S, R 5E
Location from nearest town: 7 miles S, 5 miles E. of Meadow, SD
Dates of present survey: 6 July 2006
Date last surveyed: 26-28 June, 17 October 2002
Most recent lake management plan: NA Date: NA
Management classification: Warmwater permanent
Contour mapped: 1994

Primary Species: (game and forage)
1. Rainbow trout
2. Largemouth bass

Secondary and other species:
1. Black crappie
2. Smallmouth bass

Physical Characteristics

Surface Area: 113.5 acres; Watershed: _____ acres
Maximum depth: 32 feet; Mean depth: 16 feet
Lake elevation at survey (from known benchmark): 50 % full

1. Describe ownership of lake and adjacent lakeshore property:

Cottonwood Springs Dam is owned and managed by the U.S. Army Corps of Engineers. The Corp also maintains a picnic area and a nearby campground.

2. Describe watershed condition and percentages of land use:

Cottonwood Springs' watershed is comprised of forested areas.

3. Describe aquatic vegetative condition:

Emergent vegetation was found in the inlet and on the entire south edge of the lake. Submergent vegetation was present throughout the lake.

4. Describe pollution problems:

No pollution problems were identified.

5. Describe condition of all structures, (i.e. spillway, level regulators, boat ramps, etc.):

All structures associated with Cottonwood Springs Dam are in good condition. An extended boat ramp was built in 2006 to accommodate low water levels.

Chemical Data

Water chemistry parameters were not collected at Cottonwood Springs this year.

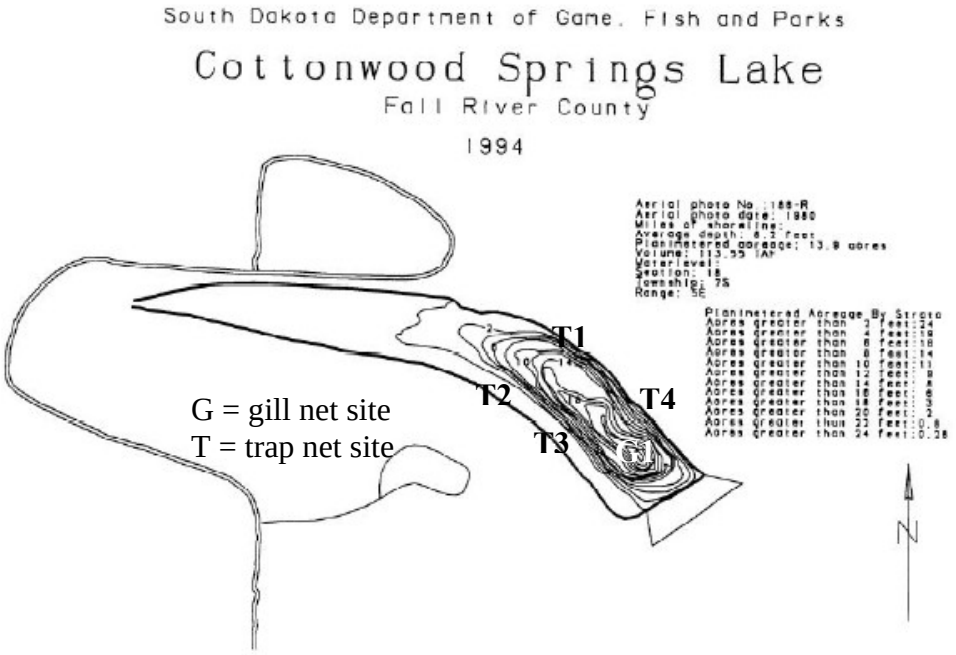


Figure 1. Lake map of sampling sites at Cottonwood Springs, Fall River County, South Dakota.

Biological Data

Cottonwood Springs Dam was surveyed on 06 July 2006 with 1 gill net night and 4 trap net nights (Figure 1). All gill nets were monofilament experimental nets. Each net was 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.1 mm (0.75 inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Six species were sampled in the gill net (Table 1). Most of these were black crappie and hatchery rainbow trout. Only one brown trout was sampled even though two stockings have occurred over the past two years. Five species were caught in trap nets (Table 2). The majority of these were black crappies.

Table 1. Total catch for one 150-ft. experimental, sinking, monofilament gill nets in Cottonwood Springs, Fall River County, South Dakota on 6 July 2006. Total number, CPUE (80% CI), CPUE-Stock (80% CI), PSD, RSD-P (90% CI), and Wr-Stock (90% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Black crappie	13	13	12	67 (25)	0	95 (2)
Green sunfish	1	1	1	0	0	81
Hatchery brown trout	1	1	na	--	--	75
Hatchery rainbow trout	10	10	na	--	--	74
Largemouth bass	1	1	1	0	0	94
Smallmouth bass	1	1	1	0	0	--
Total	**27**					

Table 2. Total catch of 4 trap-net nights in Cottonwood Springs, Fall River County, South Dakota on 6 July 2006. Total number, CPUE (80% CI), CPUE-Stock (80% CI), PSD, RSD-P (90% CI), and Wr-Stock (80% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Black crappie	31	10.3 (8.7)	10.3 (8.7)	77 (0)	0	92 (0)
Green sunfish	4	1.3 (2.5)	1.3 (2.5)	0	0	106 (10)
Hatchery brown trout	1	0.3 (0.6)	na	--	--	--
Largemouth bass	12	4.0 (5.6)	3.3 (5.4)	0	0	86 (23)
Smallmouth bass	7	2.3 (3.5)	2.3 (3.5)	0	0	79 (0)
Total	**55**					

Black Crappie

Black crappies were the main panfish sampled in Cottonwood Springs. The Wr and PSD have both decreased since the last survey in 2002 (Figure 2). The CPUE was similar to that in 2003. Growth was even slower than it was in the 2002 survey (Figure 3). Growth is far below the state average most likely due to cold water temperatures throughout most of the year. The length frequency graph indicates that most crappies are about 8 inches long (Figure 3). This average length is somewhat shorter than the 2002 survey showed.

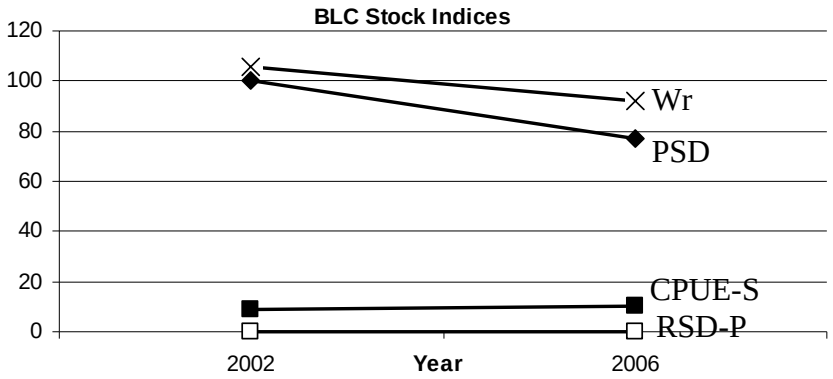


Figure 2. Stock indices for black crappie sampled from Cottonwood Springs Reservoir, Fall River County, South Dakota.

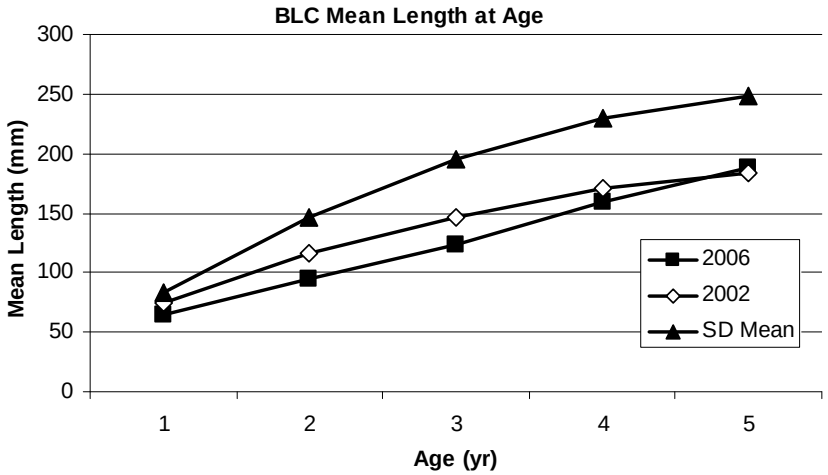


Figure 3. Growth rates for black crappies sampled from Cottonwood Springs Reservoir, Fall River County, South Dakota.

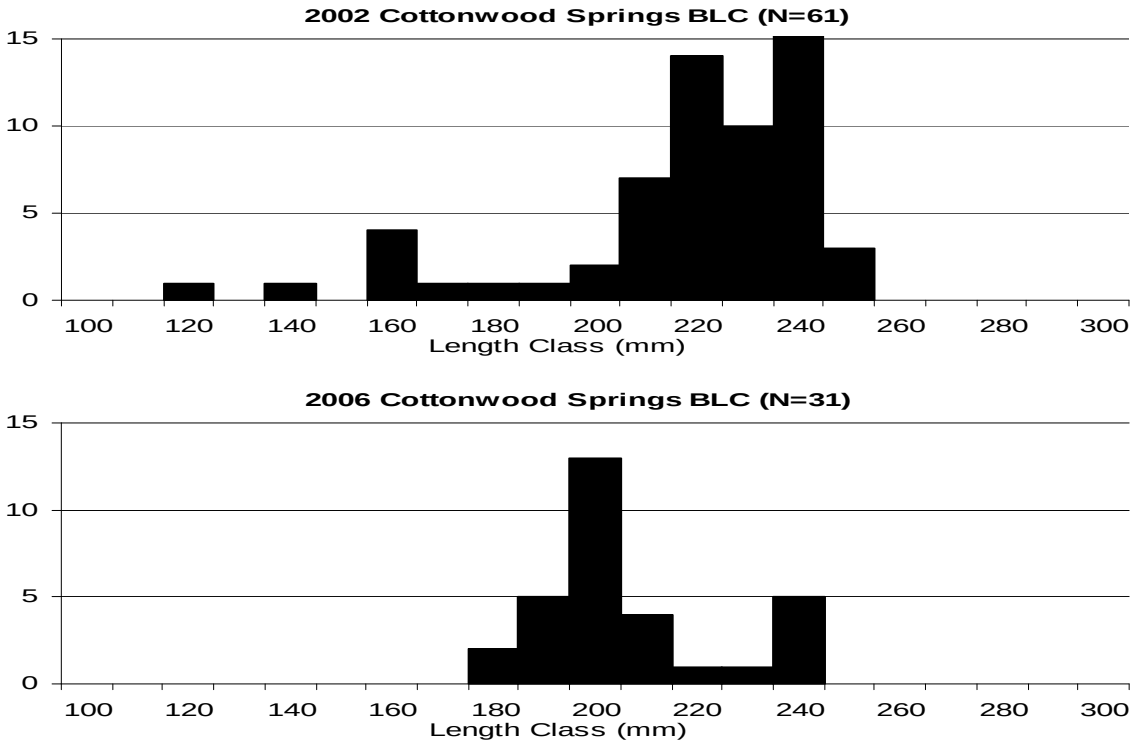


Figure 4. Length frequency histograms for black crappie in Cottonwood Springs Reservoir, Fall River County, South Dakota.

Rainbow trout

Ten hatchery rainbows were sampled in the gill nets during this survey. The fish averaged about 12-13 inches long indicated by the length frequency graph (Figure 5). Rainbow trout Wr was about 74, which is fairly low compared with other Black Hills reservoirs.

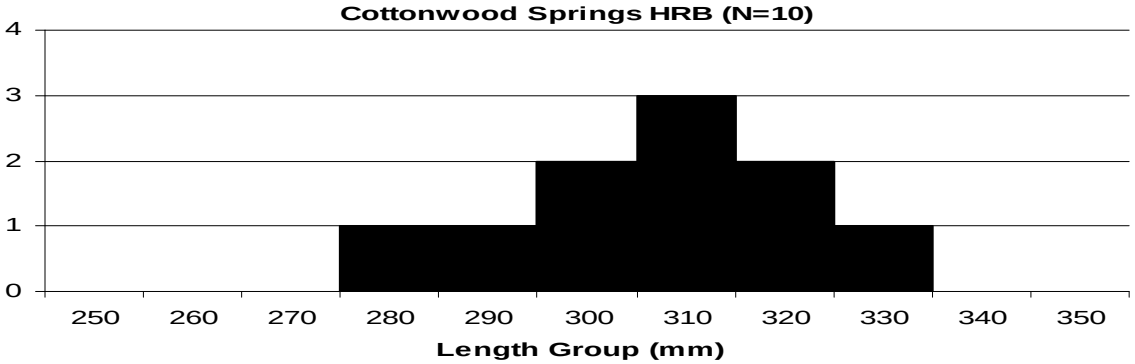


Figure 5. Length frequency histogram for hatchery rainbow trout in Cottonwood Springs Reservoir, Fall River County, South Dakota.

Other species

Only one brown trout was sampled even though two stockings have occurred. Electrofishing was not conducted so bass were not sampled effectively to report this year. Green sunfish were observed this year unlike past years.

Recommendations

1. Continue to manage as a put and take rainbow trout fishery and stock accordingly.

2. Conduct spring night electrofishing to evaluate brown trout success.

Literature Cited

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

Appendix

Appendix B. Stocking record for Cottonwood Springs Dam, South Dakota.

Year	Number	Species	Size
1997	5,000	rainbow trout	fingerling
1998	5,000	rainbow trout	fingerling
1999	7,500	rainbow trout	fingerling
2000	7,800	rainbow trout	fingerling
	188		catchable
2001	1,200	rainbow trout	catchable
2002	7,000	rainbow trout	fingerling
	2,150		catchable
2003	800	rainbow trout	catchable
	45		adult
2004	725	brown trout	catchable
	1,500	rainbow trout	catchable
2005	725	brown trout	catchable
	622	rainbow trout	catchable
2006	1,500	rainbow trout	catchable

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Waggoner Lake County(ies): Haakon
Legal description: T 1N, R 20E Sec. 1 and T 1N, R 21E Sec. 6
Location from nearest town: 3 miles north of Philip, SD
Dates of present survey:
Date last surveyed: June 28-30; September 22, 2004
Most recent lake management plan: F21-R-32 Date: 1998
Management classification: Warmwater permanent
Contour mapped: Date 1995

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Black crappie
2. Bluegill	2. Northern pike
3.	3. Yellow perch
4.	4. Green sunfish
5.	5. Walleye
6.	6. Channel catfish
7.	7. Smallmouth bass
8.	8. White sucker

PHYSICAL CHARACTERISTICS

Surface Area: 107 acres; Watershed: 16,600 acres
Maximum depth: 21 feet; Mean depth: 10 feet
Lake elevation at survey (from known benchmark): full

1. Describe ownership of lake and adjacent lakeshore property:

The State of South Dakota has an easement for public access up to 12 feet above the high water mark. A majority of the lakeshore property is privately owned with small portions owned by the city of Philip and Haakon County.

2. Describe watershed condition and percentages of land use:

Approximately 90% of the watershed consists of livestock grazing. An increasing portion of the watershed has been tilled for small grain row crops. The increased tillage has accelerated siltation of the lake. The primary source of water for Waggoner Lake is a city owned hot water well and Grindstone Creek. A continual water supply is rare for lakes in western South Dakota; the lake does experience fluctuations as the well water is also used by a nearby golf course. The hot water well provides some benefit to fish in the winter months; however, it makes ice conditions near the inlet unpredictable.

3. Describe aquatic vegetative condition:

Emergent vegetation is limited to bulrushes and cattails, which are abundant in the bays and inlet areas of the lake. Submerged vegetation is a problem annually in mid-summer. Approximately fifty percent of the shoreline was covered by submergent vegetation.

4. Describe pollution problems:

There is moderate siltation from run-off. Currently no pollution problems have been detected by Departmental personnel during lake surveys.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

A new boat ramp was put in 2004, and is a huge upgrade from the old ramps.

CHEMICAL DATA

1. Describe general water quality characteristics.

Water chemistry was measured in the field on August 31 using a YSI Sonde #6820 unit. A water profile was taken at the deepest part on the lake. The results are in Appendix B.

2. Thermocline: Yes ___ No _X_; location from surface ___ m

3. Stations for water chemistry located on attached lake map: Yes _X_ No ___

BIOLOGICAL DATA

Methods

A lake survey was conducted on Waggoner Lake June 28-30, 2004. Sampling consisted of 2 gill net nights and 8 trap net nights (Figure 2). All gill nets were monofilament experimental nets. Each net was 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at four stations consisting of 2 trap net nights each. All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.1 mm (0.75 inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at Waggoner Lake on September 28, 2006. Electrofishing was conducted using a Smith-Root control unit with pulsed-DC. Six, ten-minute runs were

completed. All smallmouth bass and largemouth bass were collected, measured for total length (TL; mm) and weighed (g). Age and growth was not calculated due to recent adult stockings. All data was entered into WinFin 2.95.

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the Smith-Root control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Fish Community Survey

Gill and Trap Net Catch

Ten species were collected during the 2006 survey of Waggoner Lake. Seven species, totaling 86 fish, were collected in experimental gill net (Table 1). Bluegills were the most abundant species present, comprising 35.4% of the total gillnet sample. Yellow perch were second most abundant at 29.3% with northern pike being third at 20.7%.

Eight species, totaling 368 fish, were collected in trap nets during the 2006 survey (Table 2). Bluegills were the most common comprising 65.5% of the total. Black crappies were second at 22.0%. Yellow perch comprised 4.3% of the trap net sample by number

Night electrofishing Catch

Waggoner Lake was night electrofished for a total of 3,000 seconds (0.83 hours) pedal time (Table 3). Only largemouth bass (N=57) and smallmouth bass (N=2) were targeted.

Table 1. Total catch (N), catch per net night, catch per net night of stock length fish, and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for all fish species collected from one 150-ft experimental sinking gill net in Waggoner Lake, Haakon County, .

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr > S
Black crappie	9	9.0	6.0	0 (--)	0 (--)	100.1 (1.5)
Bluegill	29	29.0	29.0	14 (11)	0 (--)	103.6 (1.2)
Northern pike	17	17.0	17.0	94 (10)	18 (17)	88.5 (5.1)
Smallmouth bass	1	1.0	1.0	--	--	93.7 (--)
Walleye	1	1.0	1.0	--	--	95.3 (--)
White sucker	1	1.0	1.0	--	--	100.7 (--)
Yellow perch	24	24.0	20.0	40 (19)	15 (14)	89.3 (2.1)
Totals	82					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), and proportional stock densities (PSD, RSD; 90% CI's in parentheses) for all fish species collected from 3 modified-fyke trap nets in Waggoner Lake, Haakon County, .

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr > S
Black Bullhead	7	2.3 (1.7)	2.3 (1.7)	57 (39)	57 (39)	92.4 (0.3)
Black crappie	81	27.0 (2.9)	15.7 (7.7)	11(8)	4 (5)	98.8 (0.8)
Bluegill	241	80.3 (98.1)	25.3 (30.2)	43 (10)	3 (3)	98.8 (0.8)
Golden shiner	1	0.3 (0.6)	----	----	----	----
Largemouth bass	3	1.0 (1.1)	0.7 (0.6)	----	----	99.5 (56.8)
Northern pike	12	4.0 (3.3)	4.0 (3.3)	92 (15)	17 (20)	----
White sucker	7	2.3 (3.5)	2.3 (3.5)	100 (--)	100 (--)	88.5 (6.2)
Yellow perch	16	5.3 (6.4)	5.3 (6.4)	44 (22)	6 (11)	88.0 (2.0)
Totals	368					

Table 3. Total catch (N), catch per hour of electrofishing (CPUE) with 80% CI's in parentheses, catch per hour of stock length fish (CPUE-S) with 80% CI's, and proportional stock densities (PSD, RSD-P) with 90% CI's in parentheses for largemouth bass and smallmouth bass collected by electrofishing in Waggoner Lake, Haakon County, September 28, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr > S
Largemouth bass	57	68.4 (11.9)	48.0 (10.9)	63 (14)	25 (12)	112.2 (2.4)
Smallmouth bass	2	2.4 (3.7)	2.4 (3.7)	100 (--)	50 (--)	108.8 (64.7)
Totals	59					

Black bullheads

Waggoner Lake has a low density bullhead population with a mean trap net CPUE of 2.3 (Table 2). Stock density indices also indicate a low density population with a PSD of 57 and an RSD-P of 57, but this is with a seven fish sample. In 2004, CPUE was 4.3 with a PSD of 56 and RSD-P of 35. It appears there has been some recruitment since the 2004 survey (Figure 1). Condition was good with a Wr for stock length and larger fish of 92.4. It appears that bass and pike are keeping bullheads numbers in check.

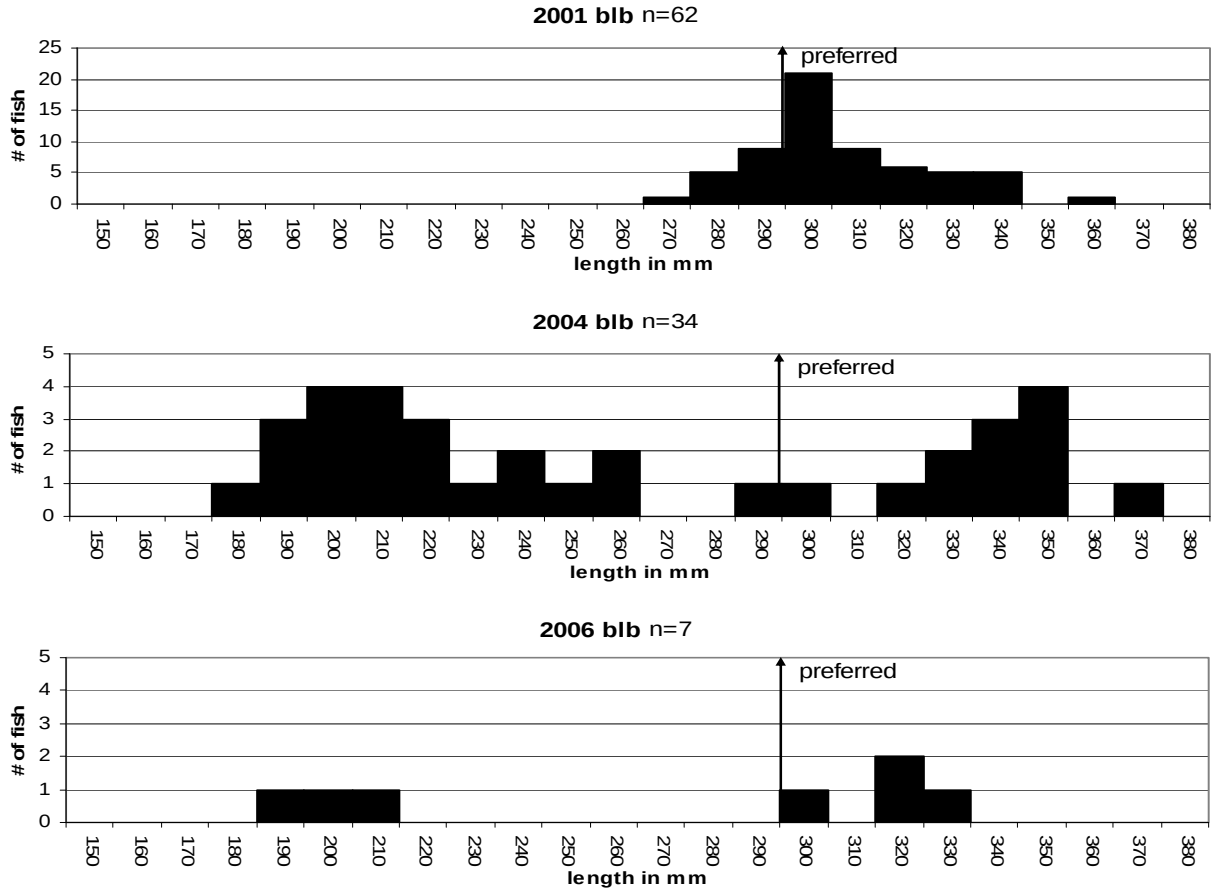


Figure 1. Length histogram of black bullheads collected in trap nets from Waggoner Lake, Haakon County, 2001, 2004, 2006.

Black crappies

Abundance of black crappies was moderate with a mean CPUE in trap nets of 27.0 (Table 2). Stock density indices were low with a PSD of 11 and an RSD-P of 4. These numbers are lower than the current management objectives. The young year classes should reach quality length by next survey. Mean condition of stock length and larger black crappies was 98.8. In 2004, black crappie CPUE was 17.6. Stock density indices were higher in 2004 with a PSD of 76 and an RSD-P of 9. Growth was above the regional average, reaching quality length at age-4 (Table 4).

Table 4. Waggoner Lake black crappie year class, age in 2006, sample size (N), mean back-calculated total length-at-age, the Region 1 mean length-at-age, and the South Dakota state-wide black crappie mean length-at-age (Willis et al 2001). Standard errors are in parentheses.

Year Class	Age	N	Age 1	2	3	4	5
2005	1	31	86				
2003	3	35	61	122	162		
2002	4	7	52	88	144	178	
2001	5	5	77	118	172	203	230
Pop. mean (SE)		**78**	**69 (8)**	**109 (11)**	**159 (8)**	**191 (13)**	**230 (0)**
Region 1			74(3)	122(7)	158(9)	197(13)	217(16)
South Dakota			83(2)	147(4)	195(5)	229 (6)	249 (6)

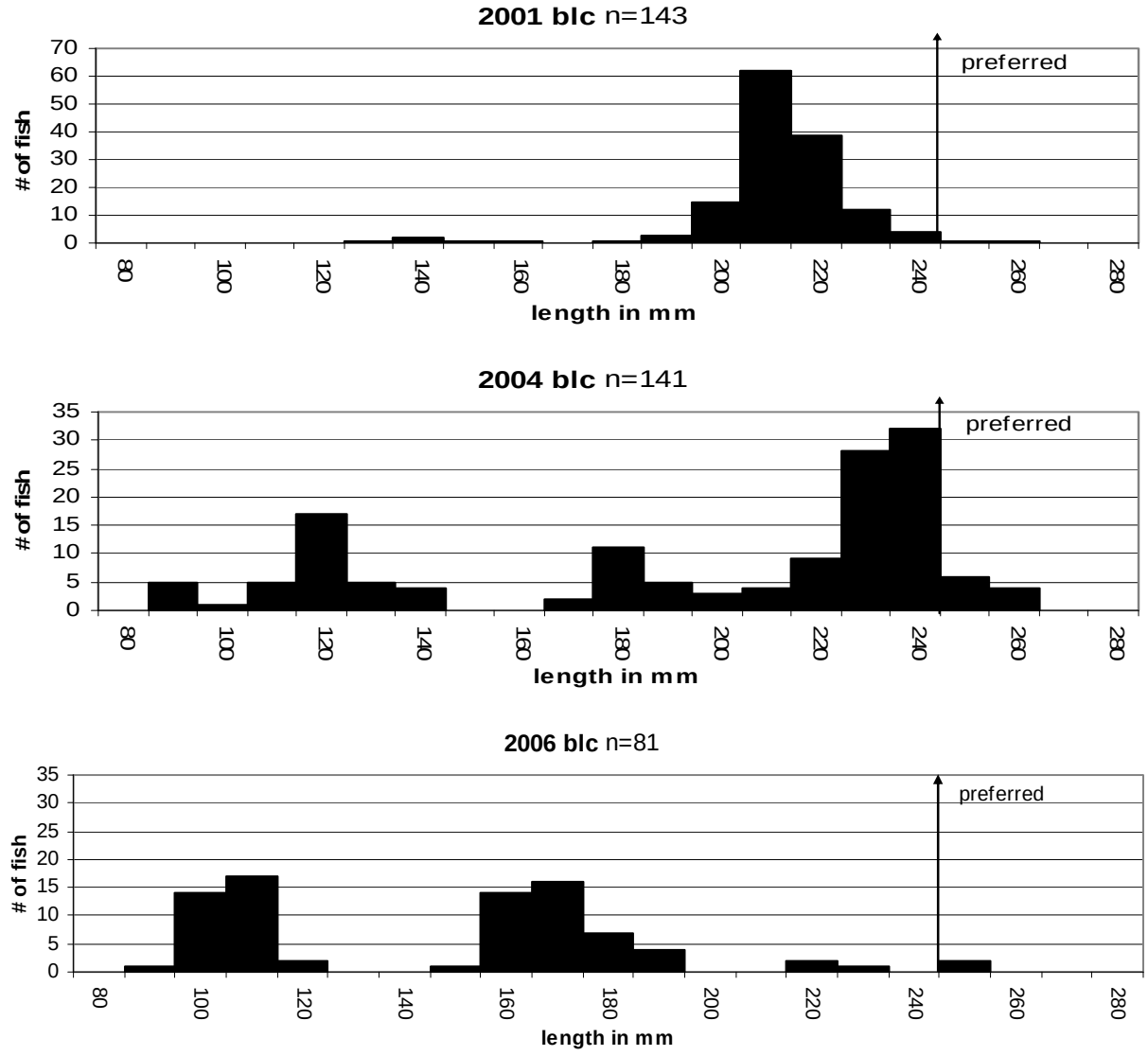


Figure 2. Length histogram of black crappies collected in trap nets from Waggoner Lake, Haakon County, 2001, 2004, 2006.

Bluegill

Bluegills were the most abundant fish captured in trap nets in 2006. CPUE was very high at 80.3, with a PSD of 43 and a RSD-P of 3 (Table 2). Bluegill mean condition was 98.8 for stock length and larger fish. The current management objective for bluegill is a PSD between 20 and 60 with an RSD-P between 5 and 20. PSD is right on the money and a little bit low on preferred length fish. Growth was good with age-5 bluegill being 10 mm longer than the regional average (Table 5). In 2004, mean CPUE in trap nets was 35.8, stock density indices were high with a PSD of 80 and an RSD-P of 28. The bluegill population appears to be doing very well. Our data indicates the population is maintaining a quality populatin in the presence of a very diverse fishery.

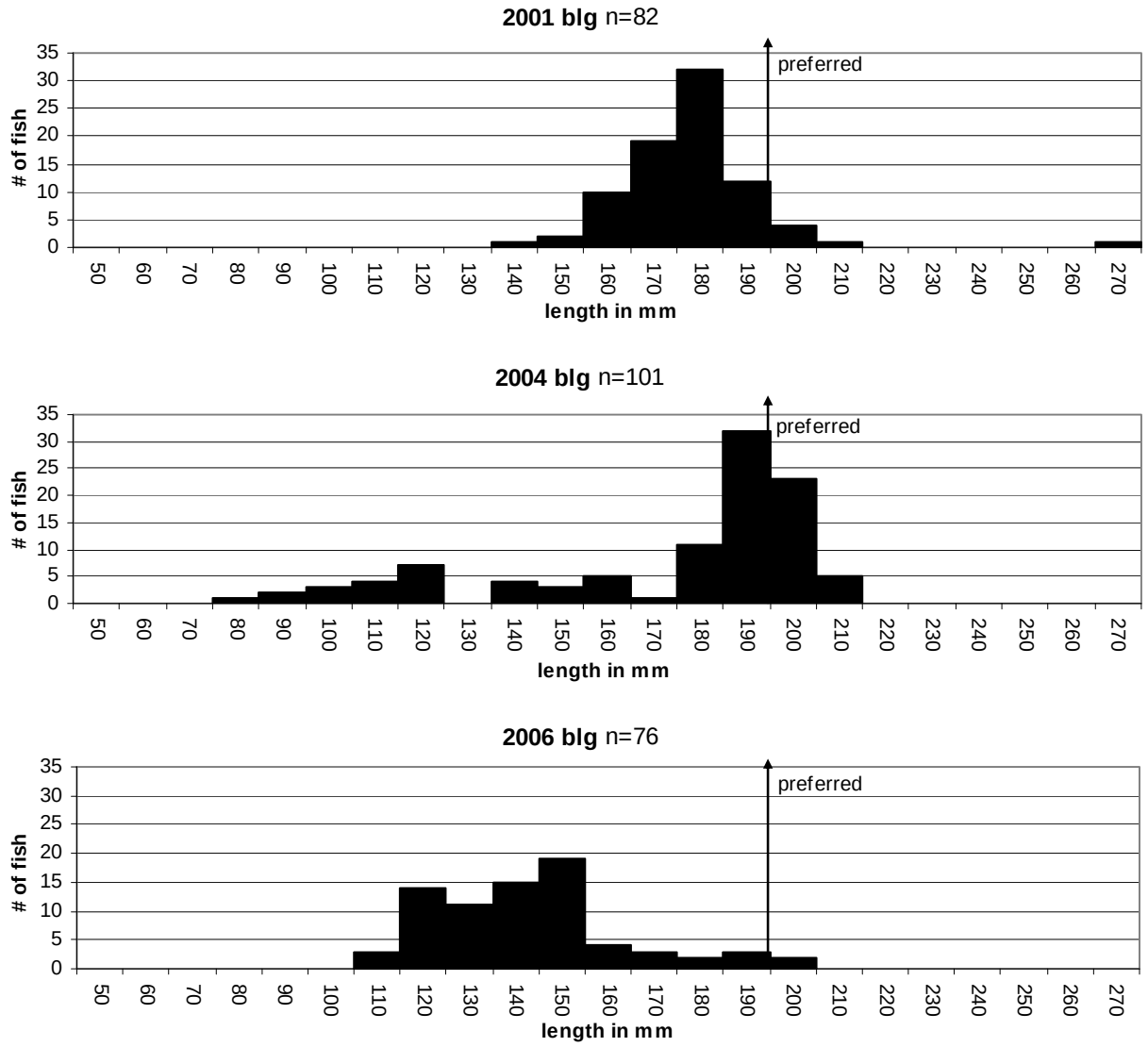


Figure 3. Length frequency histogram of bluegill collected in trap nets from Waggoner Lake, Haakon County, 2001, 2004, 2006.

Table 5. Waggoner Lake bluegill year class, age in 2006, sample size (N), mean back-calculated total length-at-age, the Region 1 mean length at age, and the South Dakota state-wide black crappie mean length-at-age (Willis et al 2001). Standard errors are in parentheses.

Year Class	Age	N	Age 1	2	3	4
2003	3	53	44	86	125	
2002	4	18	38	85	120	148
Pop. mean (SE)		**71**	**41 (3)**	**86 (0)**	**122 (2)**	**148 (0)**
Region 1			52 (5)	92 (6)	123 (5)	146 (5)
South Dakota			55 (2)	103 (3)	141 (3)	166 (4)

Largemouth bass

A total of 57 largemouth bass were captured during night electrofishing (Tables 3 and 6). Mean CPUE was 68.4 for all largemouth bass and mean CPUE for largemouth bass stock length or greater was 48.0. Size of fish collected ranged from 150 mm to 490 mm (Figure 6). Stock density indices indicate a balanced population with a PSD was 63 and RSD-P was 25. Mean Wr for stock length and larger fish was 112.2. Growth was not calculated due to recent adult stockings.

Over the years the largemouth bass population has been variable. Density and size structure were high from 1996-1999, but number declined dramatically in 2000. Adult stockings appear to be helping the population recover. Currently, bass resemble a moderate density population with excellent size structure. GF&P management plan objectives for CPUE of adult bass is greater than 20 with a PSD range of 50-80 and an RSD-P of greater than 30. Our current survey shows that we are right on target in meeting these objectives

Table 6. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for largemouth bass collected by electrofishing in Waggoner Lake, Haakon County, 1996-2006.

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P
1996	96	2,942	117.5	111.4	66 (8)	29 (8)
1997	88	6,944	45.6	42.5	63 (8)	24 (8)
1998	107	4,200	91.7	90.9	72 (8)	24 (7)
1999	111	6,350	62.9	62.4	56 (8)	17 (6)
2000	19	4,140	18.1	18.1	74 (18)	16 (15)
2001	56	6,028	33.5(4.6)	26.3(4.6)	52 (13)	0 (-)
2002	24	2,959	29.2(14.6)	29.2(14.6)	71(16)	4(7)
2003	39	3,800	38.5(21.5)	18.8(10.7)	95(9)	58(20)
2004	88	3,600	88.0(38.1)	57.0(20.7)	46(11)	35(11)
2005	77	3,898	71.0 (12.0)	59.7 (10.2)	58 (11)	32 (10)
2006	57	3,000	68.4 (11.9)	48.0 (10.9)	63 (14)	25 (12)

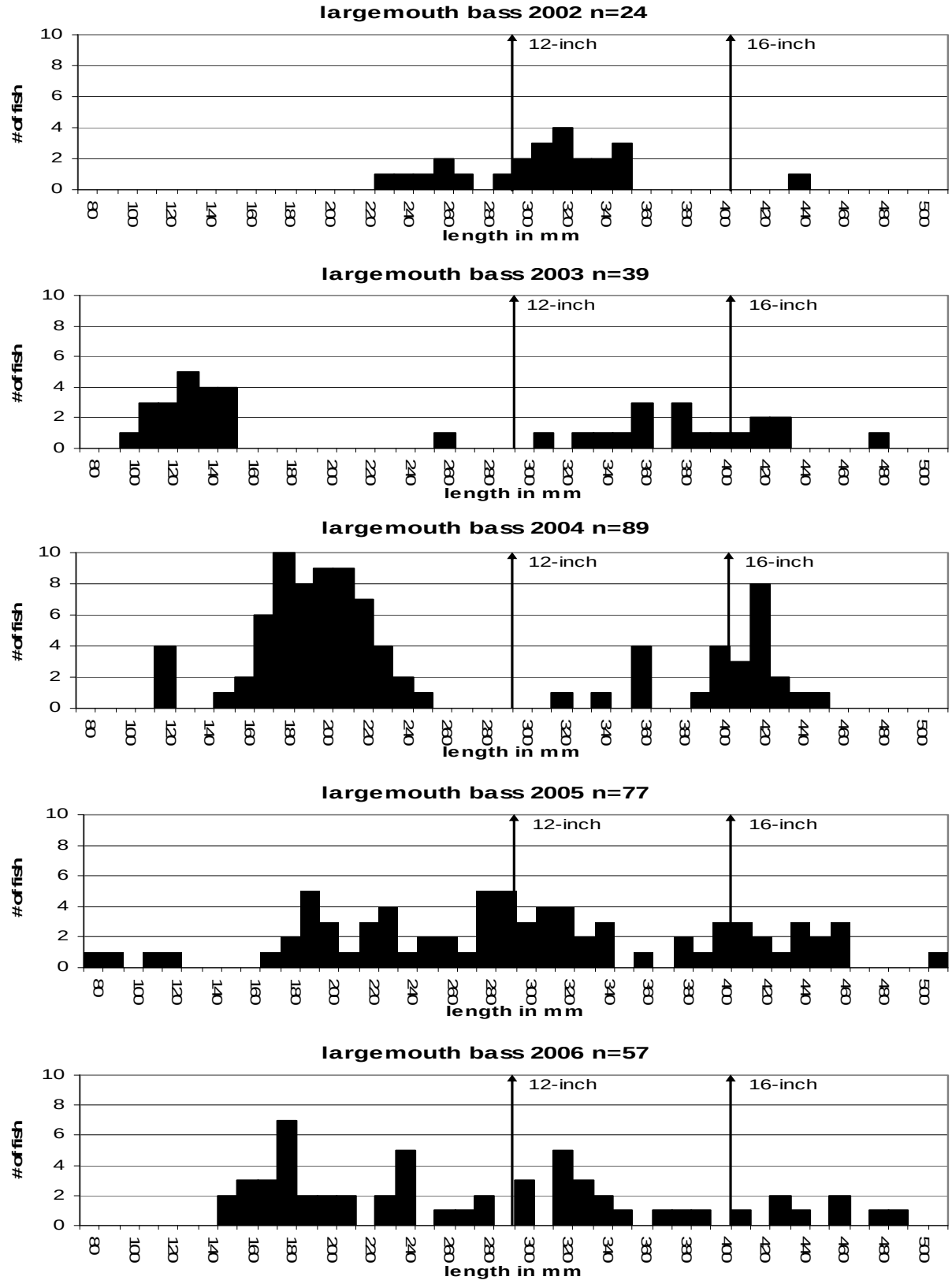


Figure 6. Length histogram of largemouth bass collected during night electrofishing from Waggoner Lake, Haakon County, 2002-2006.

Northern pike

Waggoner appears to have a healthy pike population. One gillnet caught 17 pike, and the three frame nets also sampled 12 northerns (Tables 1 & 2). In 2004, two gillnets and eight frame nets caught a total of 31 pike. Mean condition of northern pike was good with the gill net sample yielding a Wr for stock length and larger fish of 88.5. Length frequency of the combined sample shows a population of larger pike ranging from 520 mm to 820 mm (Figure 7).

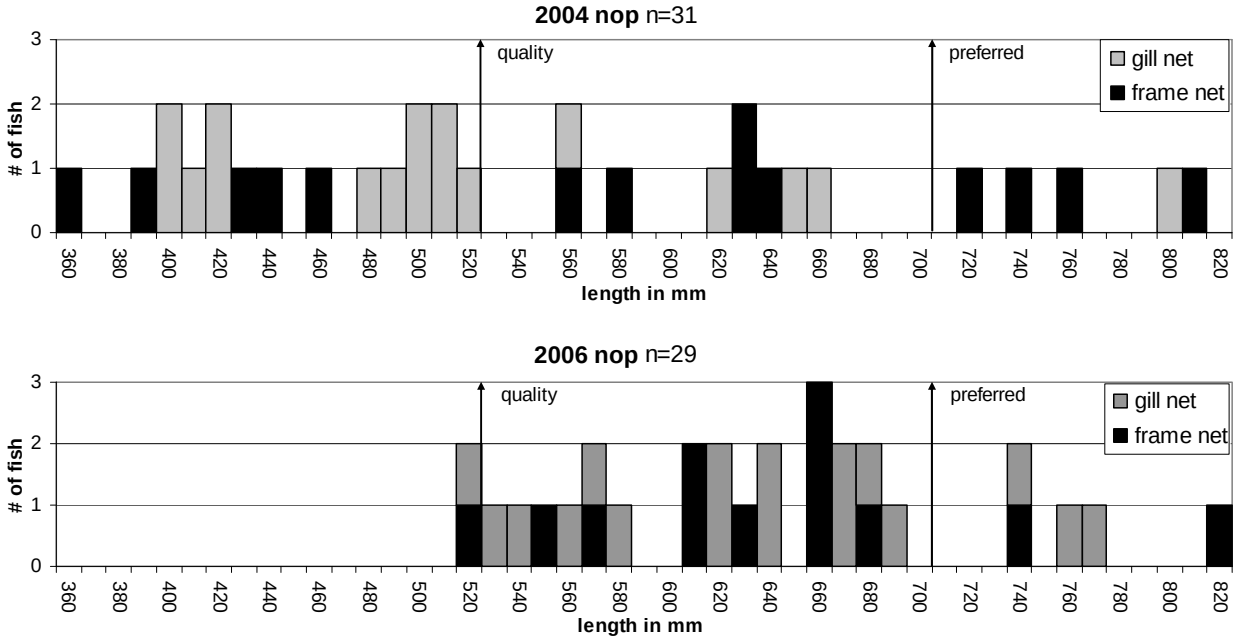


Figure 7. Length histogram of northern pike collected in trap nets and gillnets from Waggoner Lake, Haakon County, 2004, 2006.

Yellow Perch

The yellow perch population has remained stable since 2004, when a total of 82 perch were sampled from two gillnets and eight frame nets. Our single gillnet caught 24, and our three frame nets caught sixteen. Stock indices were similar between gear types (Tables 1 & 2). Gillnet PSD was 40 with an RSD-P of 15, while frame net sampled larger fish for a PSD of 44 and an RSD-P of 6. Both these samples fall with in the current management objectives for a balanced panfish population. Fish condition was also good with a mean Wr for stock length and larger fish of 89.3 for the gillnet sample and 88 for the frame net sample. The combined 40 fish sample shows a well balanced population (Figure 8). Growth was excellent, faster than the state and regional average (Table 7).

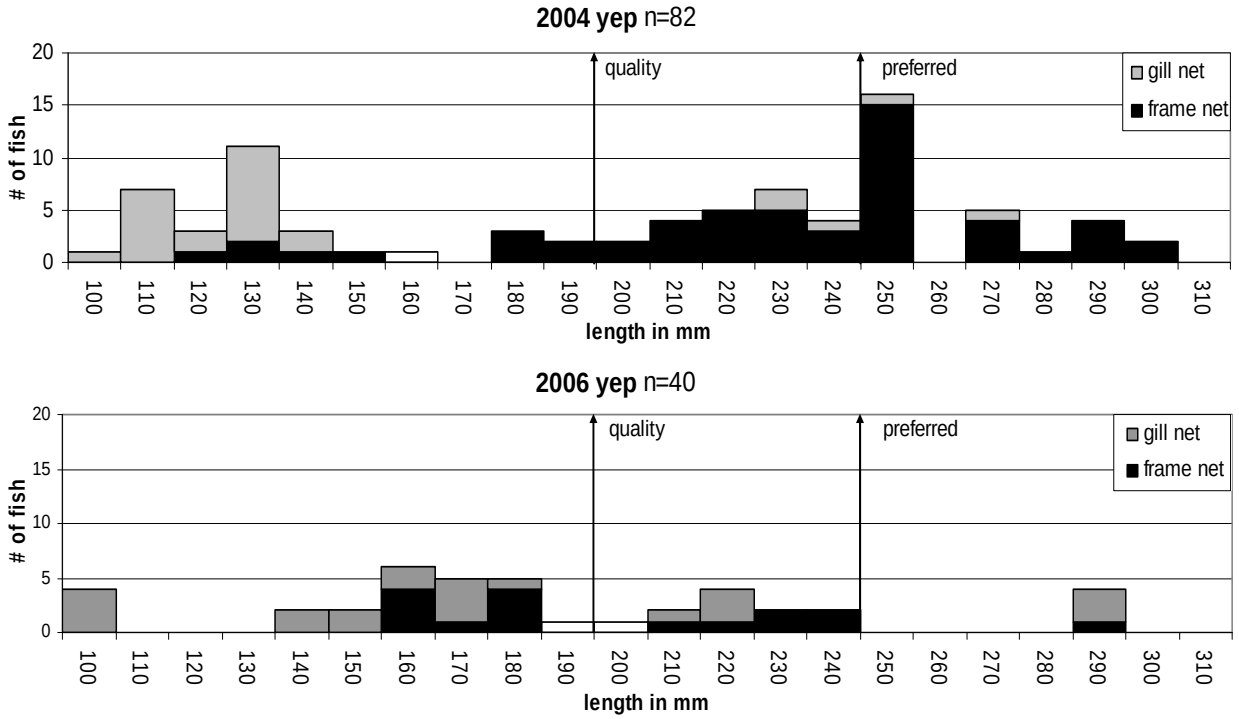


Figure 8. Length histogram of yellow perch collected from gillnets and framenets at Waggoner Lake, Haakon County, 2004, 2006.

Table 7. Waggoner Lake yellow perch year class, age in 2006, sample size (N), mean back-calculated total length at age, the Region 1 mean length at age, and the South Dakota state-wide yellow perch mean length at age (Willis et al 2001). Standard errors are in parentheses.

Year Class	Age	N	Age 1	2	3	4
2004	2	11	91	142		
2003	3	6	102	155	199	
2002	4	3	109	191	237	282
Pop. mean (SE)		**20**	**101 (5)**	**163 (15)**	**218 (19)**	**282 (0)**
Region 1			70 (3)	117 (6)	158 (6)	186 (6)
South Dakota			86 (2)	145 (4)	190 (5)	220 (5)

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting lake surveys once every 2 years to evaluate fish populations and stocking success as well as seeing if management objectives are being met.

2. Continue annual fall night electrofishing to develop long-term trend data of largemouth bass and continue monitoring the smallmouth bass population.

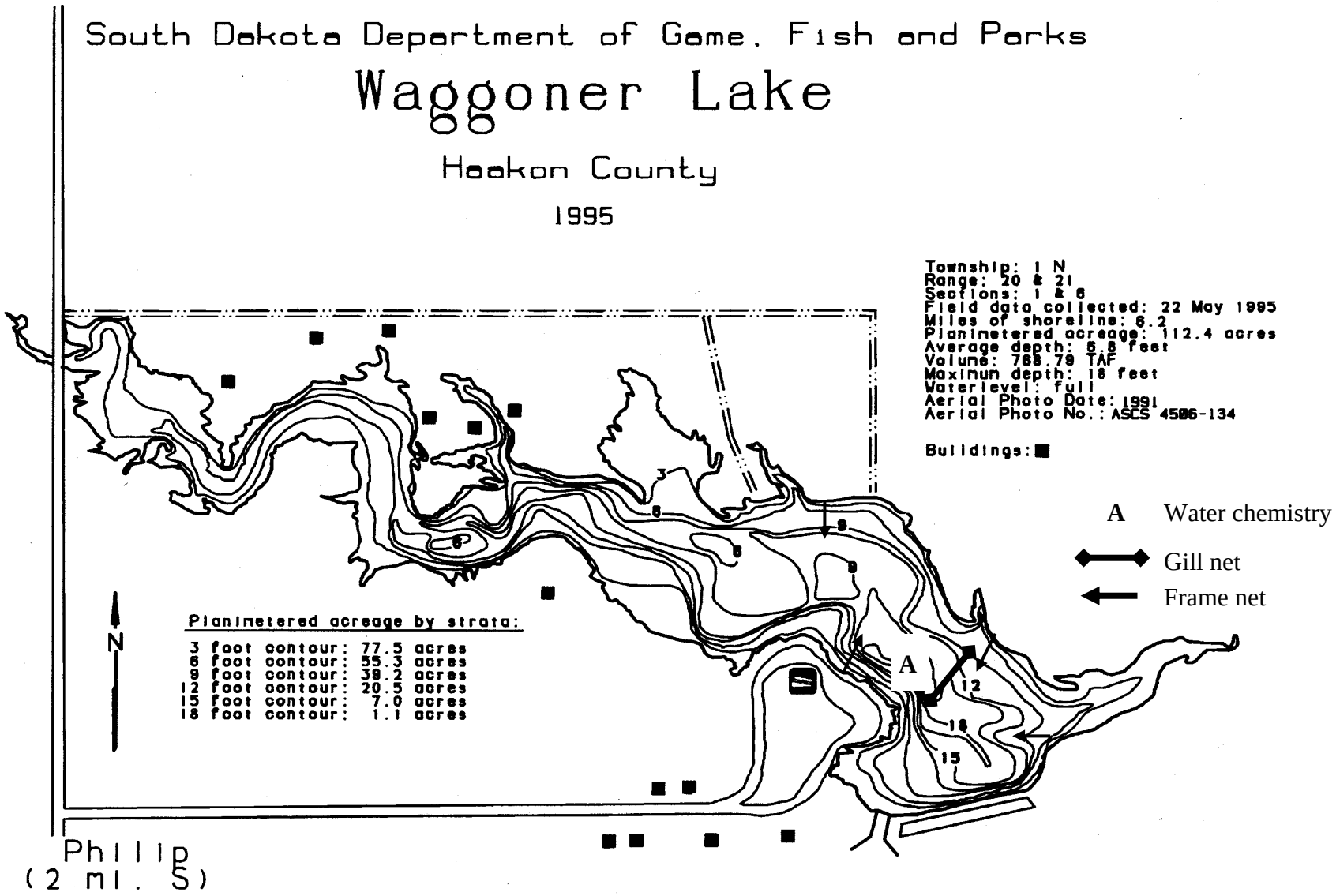
APPENDICES

Appendix A. Stocking record for Waggoner Lake, Haakon County, 1988-2006.

Year	Number	Species	Size
1988	151	Largemouth bass	Adult
	7,000	Largemouth bass	Fingerling
1990	4,000	Largemouth bass	Fingerling
1991	2,000	Largemouth bass	Fingerling
1992	9,000	Largemouth bass	Fingerling
	2,000	Golden shiner	Adult
1994	2,000	Golden shiner	Adult
	120	Largemouth bass	Adult
1995	4,000	Largemouth bass	Fingerling
1996	4,000	Largemouth bass	Fingerling
1997	12,000	Largemouth bass	Fingerling
1998	12,000	Largemouth bass	Fingerling
1999	6,000	Largemouth bass	Fingerling
2000	12,000	Largemouth bass	Fingerling
2001	905	Largemouth bass	Adults
	12,620	Largemouth bass	Fingerling

Appendix B. Waggoner Lake water chemistry profile taken on August 31, 2006.

Depth(ft)	Temperature	Disolved O2	pH
Surface	20.6	8.9	8.7
2.7	20.7	8.7	9.0
5.3	20.7	8.7	9.0
7.7	20.7	8.7	9.0
10.5	20.7	8.7	9.0
13.5	20.8	8.6	9.1



Appendix C. Map of Waggoner Lake, SD.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Gardner Lake County(ies): Harding
Legal description: T 19 N, R 4 E Sec. 10, 15, 22
Location from nearest town: 3 miles west and 1 mile north of Buffalo, SD
Dates of present survey: May 27-28, 2006
Date last surveyed: June 21-23, 2004
Most recent lake management plan: F21-R-36 Date: 2004
Management classification: Warmwater permanent
Contour mapped: Date 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Black bullhead
2. Black crappie	2. Common carp
3. Yellow perch	3. White sucker
4. Channel Catfish	4. River carpsucker
5.	5. Spottail shiner
6.	6. Fathead minnow
7.	7. Largemouth bass
8.	8. Northern pike

PHYSICAL CHARACTERISTICS

Surface Area: 203 acres; Watershed: 13,340 acres
Maximum depth: 10 feet; Mean depth: 7 feet
Lake elevation at survey (from known benchmark): -2 feet

1. Describe ownership of lake and adjacent lakeshore property:

South Dakota Department of Game, Fish and Parks owns most of the land adjacent to Gardner Lake. However, three small lakeside portions are privately owned. Game, Fish and Parks has easements, including public access, on this land.

2. Describe watershed condition and percentages of land use:

The Gardner Lake watershed is approximately 21 square miles and consists primarily of private land used for livestock grazing and limited farming.

3. Describe aquatic vegetative condition:

Due to extremely turbid water no vegetation was observed in Gardner during the 2006 survey.

4. Describe pollution problems:

No pollution problems were identified by departmental personnel during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

In 1987-88 extensive reconstruction of the dam and spillway occurred. Since the reconstruction, problems with the spillway have been identified and are currently under consideration for repair.

CHEMICAL DATA

1. Describe general water quality characteristics.

No water chemistry was done in 2006.

2. Thermocline: No

3. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted on Gardner Lake, May 27-28, 2006. Sampling consisted of 2 gill net nights and 6 trap net nights (Appendix C). All gill nets were monofilament experimental nets. Each net was 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at four stations consisting of two net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm), fish were not weighed due to 50 mph winds. In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Fish Community Survey

Overall, six species of fish were collected during the 2006 lake survey (Tables 1 and 2). Ninety eight fish were collected by frame nets with white sucker (35.7%) and channel catfish (25.5%) being the most numerous (Table 1). Only four fish were collected out of the two gillnets with channel catfish (n=2) being most abundant (Table 2). Population parameters of dominant game and forage species in Gardner Lake are discussed individually below.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses) for all fish species collected from six ¾ inch frame nets in Gardner Lake, Harding County, May 27-28, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P
Black crappie	2	0.3 (0.3)	0.3 (0.3)	--	--
Channel catfish	25	4.2 (1.5)	4.0 (1.4)	4 (7)	0 (--)
Common carp	12	2.0 (1.5)	2.0 (1.5)	75 (23)	0 (--)
Northern pike	8	1.3 (0.7)	1.3 (0.7)	63 (35)	0 (--)
Walleye	16	2.7 (1.5)	2.7 (1.5)	69 (21)	0 (--)
White sucker	35	5.8 (1.5)	5.8 (1.5)	100 (--)	100 (--)
Total	98				

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses) for all fish species collected from two 150-ft experimental sinking gill nets in Gardner Lake, Harding County, May 27-28, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P
Channel catfish	2	1.0 (0.0)	1.0 (0.0)		
Common carp	1	0.5 (1.5)	0.5 (1.5)		
Walleye	1	0.5 (1.5)	0.5 (1.5)		
Total	4				

Black crappie

Current black crappie management objectives is to increase the black crappie trap-net CPUE between 10 and 50, and maintain PSD between 50 and 80. Gardner has a way to go to achieve these objectives as black crappie catch dropped to the lowest recorded in recent history with a CPUE of 0.3 (Table 3). Recent winterkills have taken their toll on the black crappie population. In addition, consecutive years of low water levels may be suppressing crappie numbers because of the lack of spawning habitat and nursery areas for the crappie.

Table 3. Composite listing of sample size (N), catch per unit effort (CPUE; standard error is given in parentheses), mean total length (TL; standard error is given in parentheses), and proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) for black crappie collected by frame nets in Gardner Lake, 1994-2006.

Year	N	CPUE	PSD	RSD-P
1994	0	0	--	--
1996	253	31.2	95	45
1999	593	74.1	98 (1)	0 (--)
2003	67	8.4 (1.6)	77 (10)	8 (6)
2004	50	6.3 (3.2)	88 (8)	28 (11)
2006	2	0.3 (0.3)	--	--

Channel Catfish

Current catfish management objective is to maintain a channel catfish fishery with a minimum gill-net CPUE for stock-length catfish of 10 and a PSD range of 30-60. This survey our gillnet CPUE is 1.0 with a frame net CPUE of 4.2 (Table 1& 2). PSD for the frame net sample was 4. The numbers show we have a ways to go to achieve our objectives. Stocking adult channel catfish should continue when sources are available. It may be time to look at catfish spawning structures to increase reproduction potential.

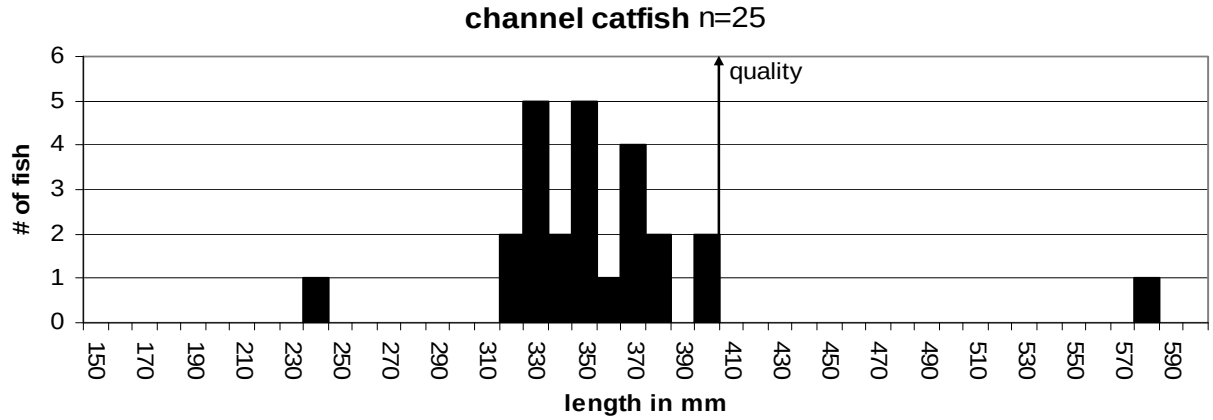


Figure 1. Length frequency of channel catfish collected by and frame nets in Gardner Lake, 2006.

Common carp

Frame net catch per effort was 2.0 with a gill net CPUE of 0.5 (Tables 1 and 2).
In 2004, no carp were sampled in the two gillnets, and three were caught in the frame nets. Efforts should be made to keep predator densities high to keep rough fish in control.

Northern Pike

The pike population in Gardner remains stable with a frame net CPUE of 1.3 compared to 2.9 in 2004. Five of the eight pike were over 530 mm. No small pike were observed probably due to lack of spawning habitat caused by low water.

Walleye

The current management objective for walleye in Gardner Lake is to maintain a walleye fishery with a minimum gill-net CPUE for stock-length walleye of 10, a PSD range of 30-60, RSD-P of 10 or greater, and a growth rate of 35.5 cm at age-3. Right now Gardner continues to maintain a low density walleye population through natural reproduction and stocking which is not even close to the objectives. Previous to the 2004 and 2006 fingerling stockings the lake hasn't been stocked since 1983. There appears to be several year classes present that must have hatched before the recent stockings.

In 2004, gill net CPUE was 1.5 and frame net CPUE was 0.5. This year our frame net CPUE was 2.7, while our gill net CPUE was 0.5. PSD for the 16 fish trap net sample was 69. Gardner appears to have a low-density, fast growing, self-sustaining walleye population. To provide a higher density population, large fall fingerling were stocked in 2004 and again in 2006 to supplement the existing population and provide more consistent walleye fishing. In addition, prespawn yellow perch were stocked in 2005 along with 100 Christmas trees, in hopes of establishing a perch fishery and a forage base. No recruitment from this effort was seen in the 2006 survey.

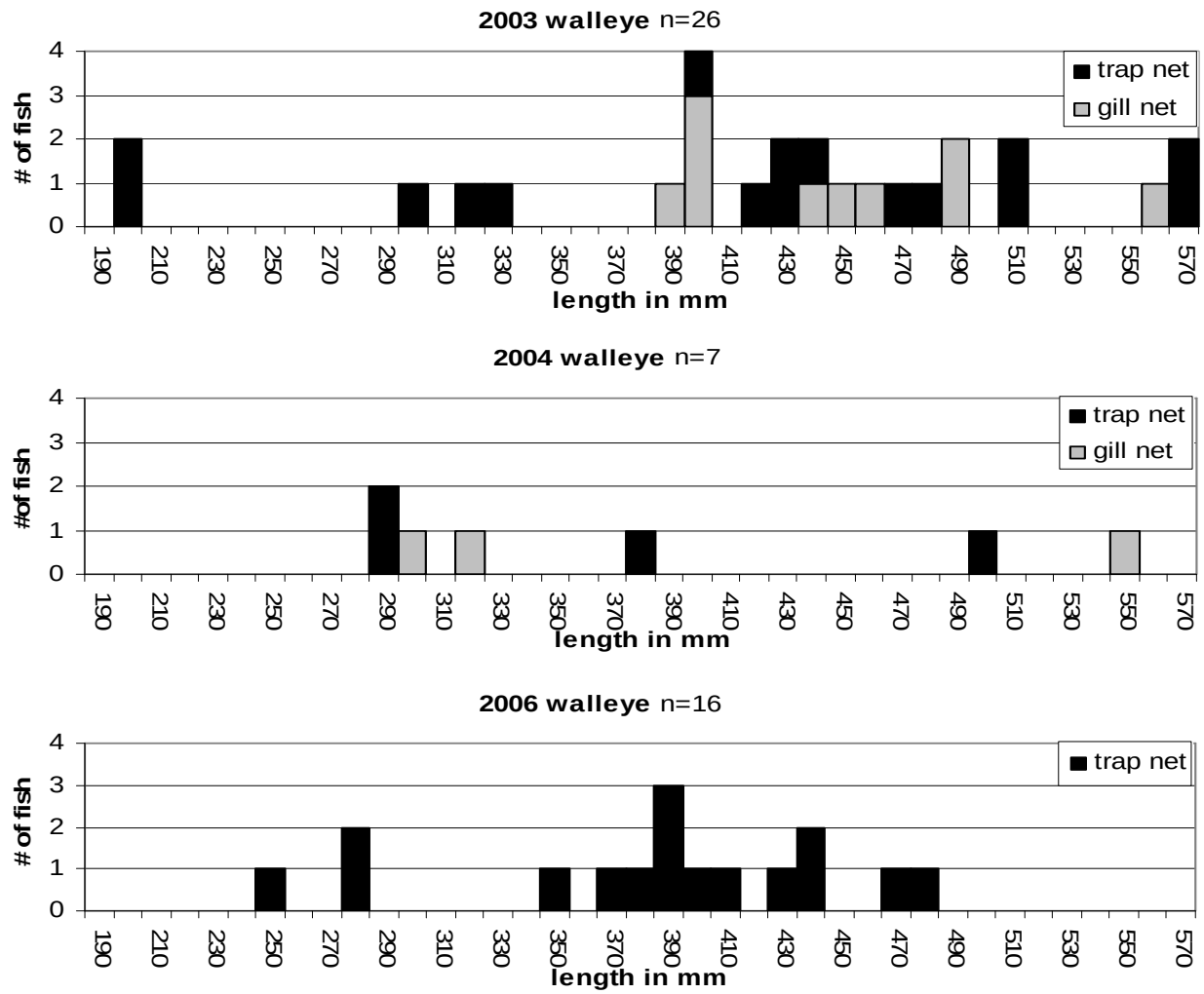


Figure 2. Length frequencies of walleye collected by gill nets and frame nets in Gardner Lake, 2003-2006.

White sucker

The most abundant fish sampled was white sucker with a frame net CPUE of 5.8. In 2004, sucker frame net CPUE was 0.1. Since all suckers sampled were large, our gear must have missed them last survey. Length frequency shows the sample is dominated by large fish. With our early sampling date, suckers were still spawning. This explains the increased number, as fish were in the shallows and more susceptible to our gear. It may also explain why the sample was all older mature fish.

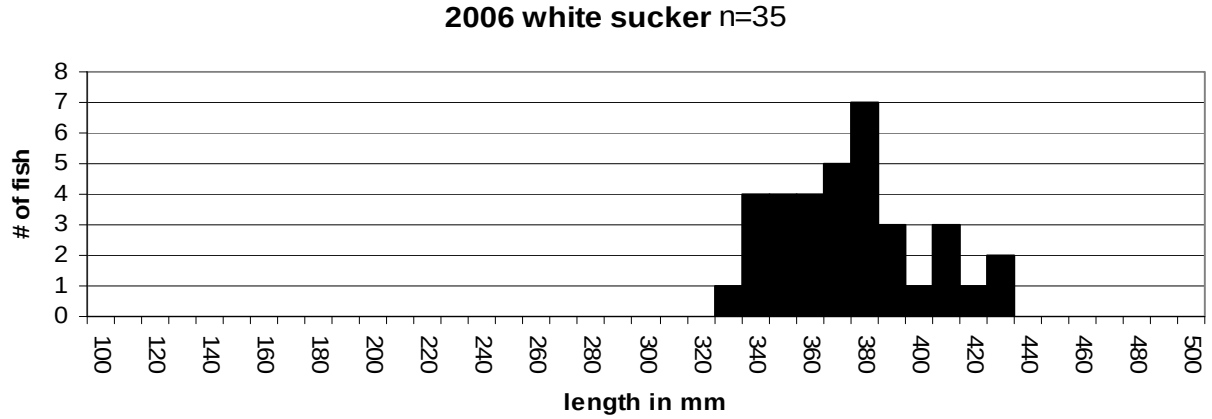


Figure 3. Length frequencies of white sucker collected by frame nets in Gardner Lake, 2006.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

1. Stock Gardner with large fall walleye fingerlings at a rate of 20 per acre every other year. This should increase predator abundance which should help keep control of carp numbers, as well as help improve angler catch rates.

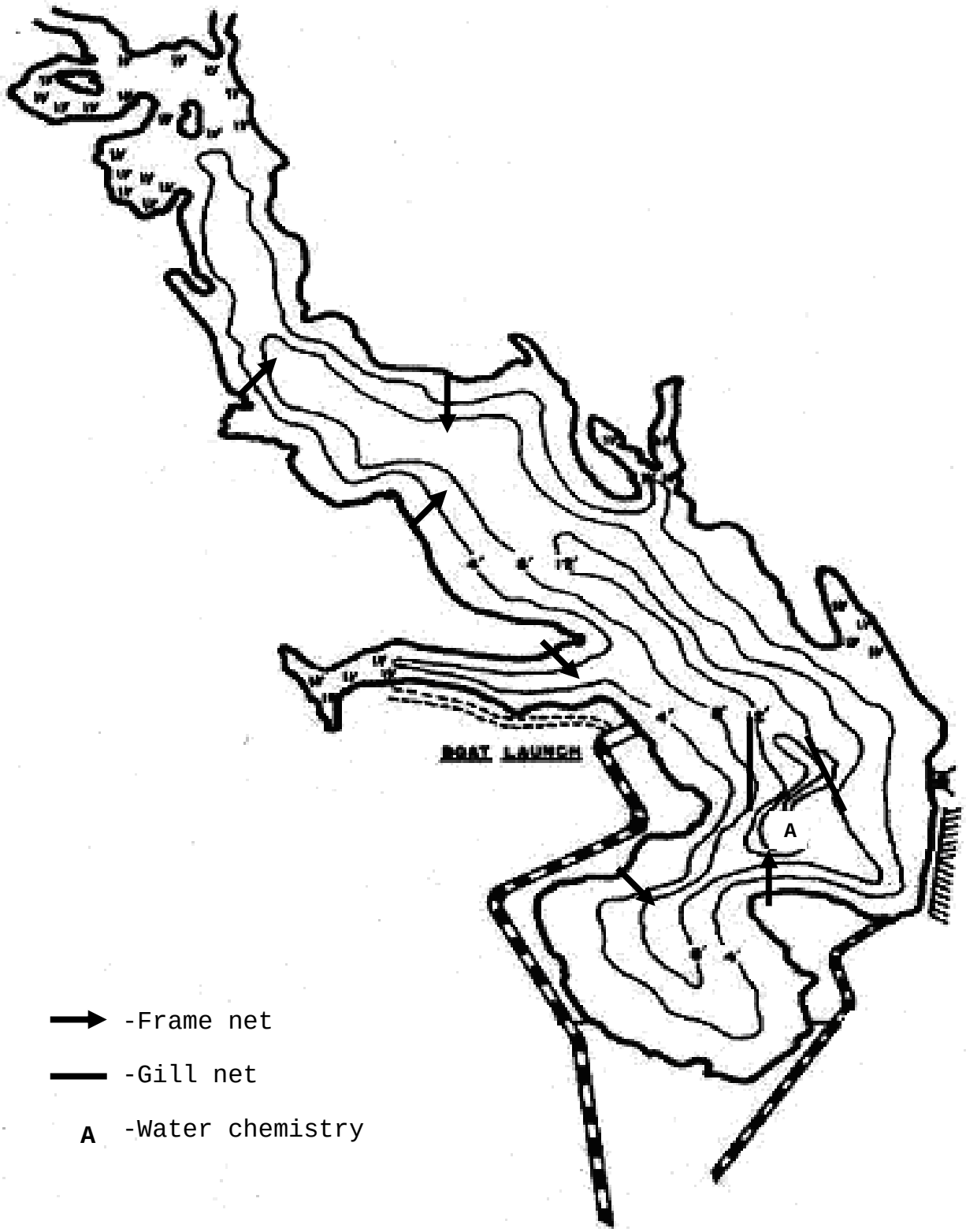
2. If water conditions allow, stock prespawn yellow perch and black crappie to help provide a better panfishery and increase walleye forage. Add Christmas tree structures to provide spawning habitat.

3. Stock channel catfish when available and look into putting in channel catfish spawning structures.

APPENDICES

Appendix A. Stocking record for Gardner Lake, Harding County, 1991-2006.

Year	Number	Species	Size
1991	20,000	Largemouth bass	Fingerling
1996	280	Black crappie	Adult
	151	Channel catfish	Adult
1997	800	Black crappie	Adult
	60	Channel catfish	Adult
1998	107	Channel catfish	Adult
2003	310	Channel catfish	Adults
2004	5,759	Walleye	Large fingerling
	912	Channel catfish	Adults
2005	368	Yellow perch	Adult
2006	1,000	Largemouth bass	Fingerling
	800	Walleye	Large fingerling



Appendix C. Map of Gardner Lake net locations and water chemistry.

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Curlew Lake County: Meade
Legal description: T 3N, R 11E Sec. 2, 10, 11
Location from nearest town: 8 mi. N, 4 mi. E, 1.5 mi. N of New Underwood, SD
Dates of present survey: June 26-28, 2006; October 13, 2006
Date last surveyed: June 14-16, 2005; October 21, 2005
Most recent lake management plan: F21-R-36 Date: 2004
Management classification: Warmwater permanent
Contour mapped: Date: July 1994

Primary Species: (game and forage)	Secondary and other species:
1. Black crappie	1. Bluegill
2. Largemouth bass	2. Yellow perch
3. Northern pike	3.
4. Walleye	4.

PHYSICAL CHARACTERISTICS

Surface Area: 136 acres; Watershed: 12,800 acres
Maximum depth: 22 feet; Mean depth: 10.2 feet
Lake elevation at survey (from known benchmark): -8 feet

1. Describe ownership of lake and adjacent lakeshore property:

Curlew Lake is owned and managed by the Department of Game, Fish and Parks. All land bordering the immediate shoreline, excluding three quarter sections in Section 2 and a small tract of land comprising 10 acres in Section 11, are owned by South Dakota Department of Game, Fish and Parks. The 10-acre tract in Section 11 has a written access agreement with the landowner; the three quarter sections in Section 2 do not have active access agreements. There is no record of problems regarding public access across this section of land.

2. Describe watershed condition and percentages of land use:

Curlew Lake watershed is comprised of 80% range and pasture lands and 20% cropland.

3. Describe aquatic vegetative condition:

Rooted aquatic vegetation appears along most of the shoreline. Bulrush is the primary emergent plant species associated with the lake. Coontail and grassy pondweed are abundant submersed vegetative species in the lake.

4. Describe pollution problems:

Siltation at inlets and shorelines due to natural erosion around the reservoir and cattle grazing on the private tract and its shoreline has decreased depth and area within the lake. No other pollution problems were identified by department personnel during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All access and regulatory structures appear to be in adequate condition.

CHEMICAL DATA

1. Describe general water quality characteristics.

Values for dissolved oxygen and temperature were measured using a YSI Model 57 Dissolved Oxygen Meter and are presented in Appendix B. The deepest depth found during sampling was only 11 feet. Dissolved oxygen was high throughout the column during the sample and would appear to not pose problems for the fishery. PH was a bit basic but certainly within comfortable levels for fish.

2. Thermocline: No

3. Secchi disc reading: ft

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

Netting Survey

A lake survey was conducted on June 26-28, 2006. Sampling consisted of 2 gill net nights and 7 trap net nights (Appendix C). All gill nets were monofilament experimental nets. Each net was 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at four stations consisting of two nights per station. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Electrofishing Survey

Night electrofishing was conducted at Curlew Lake on October 13, 2006. Electrofishing was conducted using a Smith-Root control unit with pulsed-DC. Four, ten-minute stations were completed during the survey. All largemouth bass and walleye were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95.

Data Analysis

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

Curlew Lake is an important coolwater fishery located about thirty minutes from Rapid City. It is a favorite location for many Rapid City anglers in search of walleye, largemouth bass, black crappie and other panfish species. During this survey no black crappie were sampled over a length preferred by anglers. In efforts to improve panfish quality and walleye catch rates, a 14-inch minimum length limit was imposed on walleye starting in 2004. Curlew is also scheduled to receive biannual stockings of large, fall walleye fingerlings. These two management strategies should help improve this valuable fishery.

Fish Community Survey

Overall, nine fish species were collected during the lake survey conducted June 26-28, 2006 in Curlew (Tables 1 and 2). Thirteen hundred twenty six fish were collected in frame nets, with black crappies comprising 94.1% of the total. Bluegills were a distant second at 3.5%. Other species sampled, in order of abundance, were yellow perch, black bullhead, common carp and walleye.

The gillnet catch was dominated by yellow perch, which comprised 39.1% of the total. Second was common carp at 21.7%. Other species sampled in the gill nets include black crappie, northern pike, golden shiner, walleye and white sucker. Population parameters of the dominant game fish species in Curlew are discussed individually below.

During night electrofishing 23 largemouth bass and 10 walleye were captured in 2,187 seconds of pedal time on 10/13/2006. Of the largemouth bass only 16 were over stock length. Eight walleye caught were over stock length and two were young of year indicating some natural reproduction.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from seven, ¾ inch trapnets in Curlew Lake, Meade County, June 26-28, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Black Bullhead	4	0.6 (0.6)	0.6 (0.6)	100 (--)	50 (--)	103.6 (5.0)
Black Crappie	1248	178.3 (97.8)	12.3 (9.2)	91 (6)	0 (--)	84.5 (0.2)
Bluegill	46	6.6 (2.3)	6.4 (2.2)	4 (6)	4 (6)	115.1 (0.6)
Common Carp	1	0.1 (0.2)	--	--	--	--
Walleye	1	0.1 (0.2)	0.1 (0.2)	--	--	105.0 (--)
Yellow Perch	26	3.7 (1.8)	2.7 (1.5)	11 (12)	5 (9)	82.9 (2.3)
Total	1326					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all species collected from two 150-ft experimental sinking gill nets in Curlew Lake, June 26-28, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Black Crappie	3	1.5 (4.6)	0.0 (--)	--	--	--
Common Carp	5	2.5 (4.6)	0.5 (1.5)	--	--	88.9 (--)
Golden Shiner	1	0.5 (1.5)	--	--	--	--
Northern Pike	1	0.5 (1.5)	0.5 (1.5)	--	--	100.3 (--)
Walleye	3	1.5 (4.6)	1.5 (4.6)	--	--	90.5 (5.6)
White Sucker	1	0.5 (1.5)	0.5 (1.5)	--	--	87.8 (--)
Yellow Perch	9	4.5 (1.5)	4.5 (1.5)	11 (21)	11 (21)	85.8 (3.9)
Total	23					

Table 3. Total catch (N), catch per hour of electrofishing (CPUE), catch per hour of stock length and larger (CPUE-S), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass and walleye collected by electrofishing in Curlew Lake, 10/13/2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Largemouth bass	23	37.7 (22.7)	25.7 (15.7)	38 (22)	25 (20)	112.7 (2.2)
Walleye	10	17.5 (11.6)	14.5 (13.7)	63 (34)	50 (36)	93.2 (3.5)

Black bullhead

CPUE of bullheads in trap nets from Curlew decreased from 23.5 in 2003 to 0.9 last year and 0.6 this survey. The gill nets caught no bullhead as they did last year. All fish captured were greater than 230 mm. The absence of small bullheads may be a sign of preference for bullheads by the bass and walleye populations. Mean relative weight (Wr) for stock length and larger bullheads was 103.6 (Table 1).

Black Crappie

Curlew's fish community was dominated by black crappie with a frame net CPUE of 178.3. Most of these fish are under stock length (Figure 1) with a CPUE-S of 12.3, which shows excellent recruitment. A current management objective is to keep CPUE under 100. In 2005, CPUE was 22.3 (Table 4). Most of the fish this year were under stock length with a CPUE-S was 12.3, which is actually lower than last year's CPUE-S which was 22.3. PSD was 91 with an RSD-P of 0 which is similar to 2005 when PSD was 75 and RSD-P was 0. Fish condition was average with a Wr for stock length and larger fish of 84.5. Growth was slower than the state average (Table 5). Another management objective was to have an RSD-P of over 5. This hasn't improved in recent history.

The walleye stocking program and regulation hasn't improved the size structure and growth of black crappie in Curlew. Predator densities need to be higher to control crappie density. If the crappie management objectives are to be met, largemouth bass densities need to increase. It may be time to look at a minimum length limit on bass.

Table 4. Composite listing of catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for black crappie collected from seven, ¾ inch trapnets in Curlew Lake, Meade County, 2000-2006.

Year	CPUE-S	PSD	RSD-P	Wr≥S
2000	120.0 (60.0)	26 (3)	0 (--)	--
2003	101.2 (95.4)	79 (3)	1 (1)	93.3 (0.7)
2005	22.3 (6.5)	75 (6)	0 (--)	89.7 (1.0)
2006	12.3 (9.2)	91 (6)	0 (--)	84.5 (0.2)

Table 5. Curlew lake black crappie year class, age in 2006, sample size (N), mean back-calculated total length at age, population standard error (SE), the 2000 mean length at age, and the South Dakota black crappie mean length at age (Willis et al. 2001).

Year			Age						
Class	**Age**	**N**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2005	1	120	73						
2003	3	6	65	129	168				
2002	4	56	74	122	169	197			
2001	5	10	67	130	170	193	214		
2000	6	10	75	137	180	199	211	225	
1999	7	4	71	132	165	188	209	220	232
Sample size		206							
Mean(SE)			**71(2)**	**130(2)**	**170(3)**	**194(2)**	**211(2)**	**223(3)**	**232(0)**
SD mean			83 (2)	147 (4)	195 (5)	229 (6)	249 (6)		

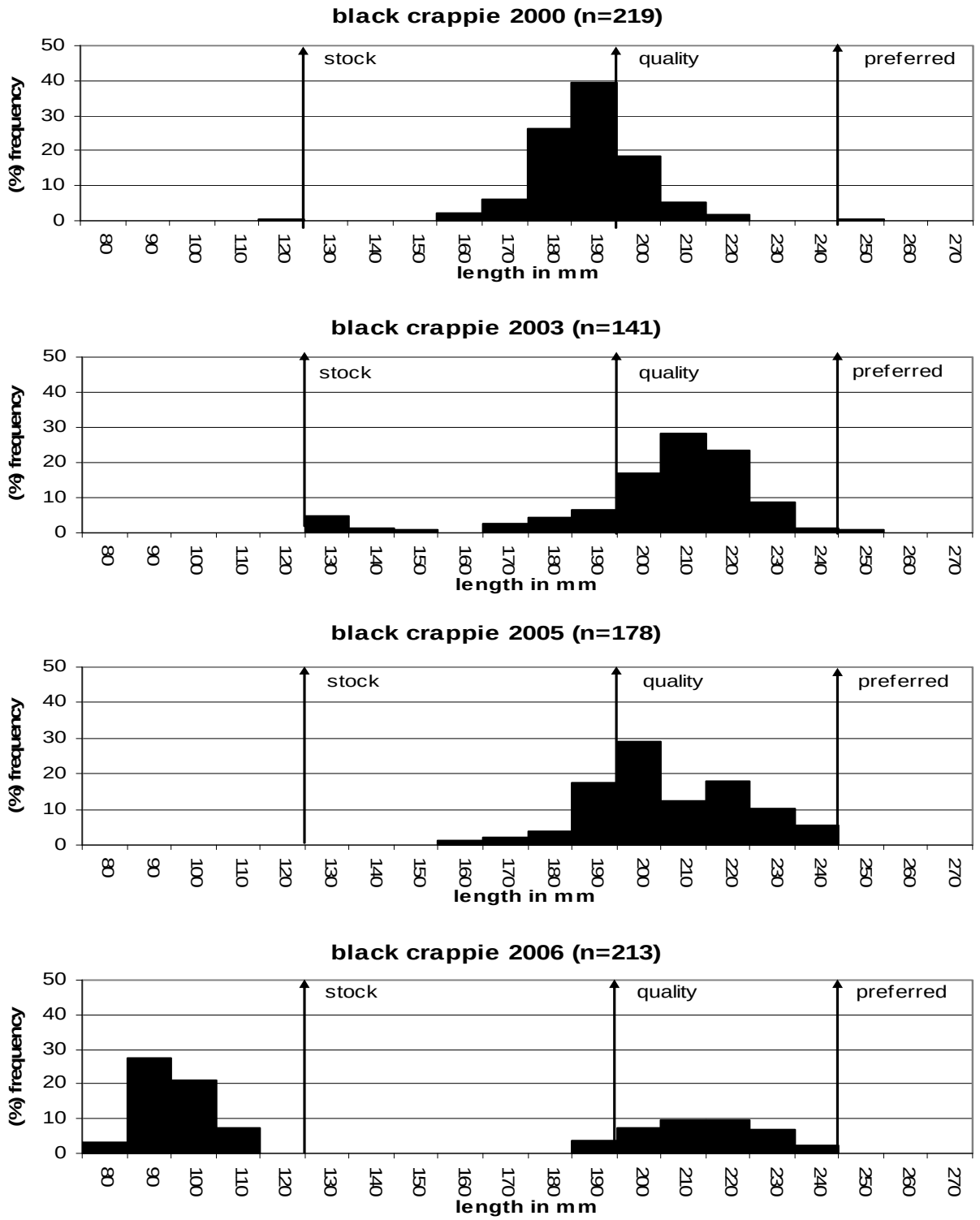


Figure 1. Length frequency histogram of black crappie from frame nets at Curlew Lake from 2000-2006.

Bluegill

In 2006, bluegill became a major player in the frame net survey with a CPUE of 6.6 and a CPUE-S of 6.4 (Table 1). Last year, no bluegills were sample by either gear type, showing the inability to catch bluegills at times. Length frequency shows a few large fish with a good year class in the 120 mm area (age 2). Fish condition was excellent with a Wr of 115.1. PSD was 4 with a RSD-P of 4.

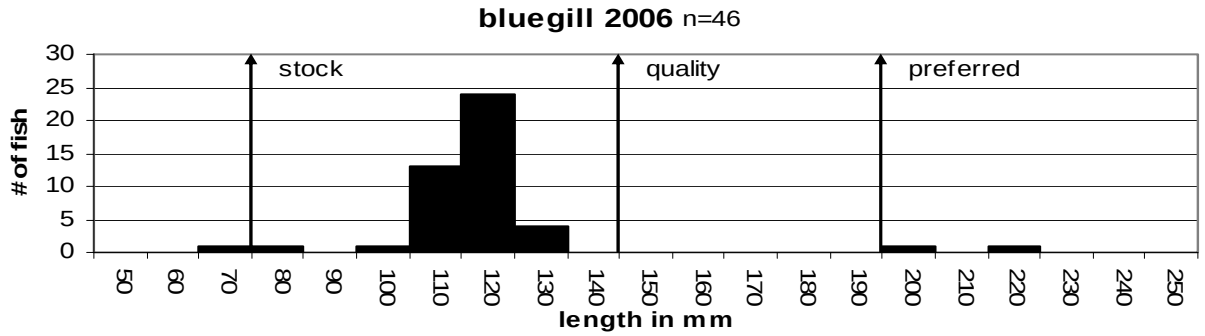


Figure 2. Length frequency histogram of bluegill from frame nets at Curlew Lake in 2006.

Largemouth bass

A total of 23 fish were collected during electrofishing, of which only 16 were over eight inches (Table 6). Adult bass density was low to moderate with a CPUE for stock length and larger bass of 25.7. CPUE for all bass was 37.7, showing a few substock fish (age-0 & 1). Stock indices indicate a fairly balanced size structure with a PSD of 38 and a RSD-P of 25. Bass condition remains excellent with mean Wr for stock length and larger bass of 112.7 and growth was excellent and higher than the state average (Table 7).

Time will tell if bass density is high enough to control panfish numbers. At this point, the drought may be reducing bass recruitment but with the amount of pressure this lake receives, it may require a minimum length regulation on bass, in addition to the walleye strategy, to get the crappie size structure into the objective range.

Table 6. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), catch per hour of stock length and larger (CPUE-S), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in Curlew Lake, 2000-2006.

Year	N	Pedal Time (seconds)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
2000	54	7,202	27.0	25.0	58 (12)	24 (10)	114.4 (3.8)
2001	64	7,909	29.9 (6.4)	15.8 (5.1)	77 (12)	3 (5)	114.7 (2.0)
2003	156	3,600	156.0 (28.7)	46.0 (16.6)	41 (13)	15 (9)	113.2 (1.0)
2004	44	3,806	39.6 (16.5)	23.6 (9.4)	65 (17)	31 (16)	110.6 (2.3)
2005	326	2,837	417.6 (117.5)	23.5 (6.7)	28 (19)	17 (16)	120.3 (1.9)
2006	23	2,187	37.7 (22.7)	25.7 (15.7)	38 (22)	25 (20)	112.7 (2.2)

Table 7. Curlew Lake largemouth bass age in 2006 from electrofishing, sample size (N), mean back-calculated total length at age, mean SD length at age, and population standard errors (SE) (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5
2005	1	13	97				
2004	2	4	120	205			
2003	3	2	69	180	247		
2001	5	3	115	220	268	316	362
total		22					
2006 Mean (SE)			**100(12)**	**201(12)**	**257(10)**	**316(0)**	**362(0)**
SD Mean (SE)			96 (3)	182 (6)	250 (7)	305 (8)	

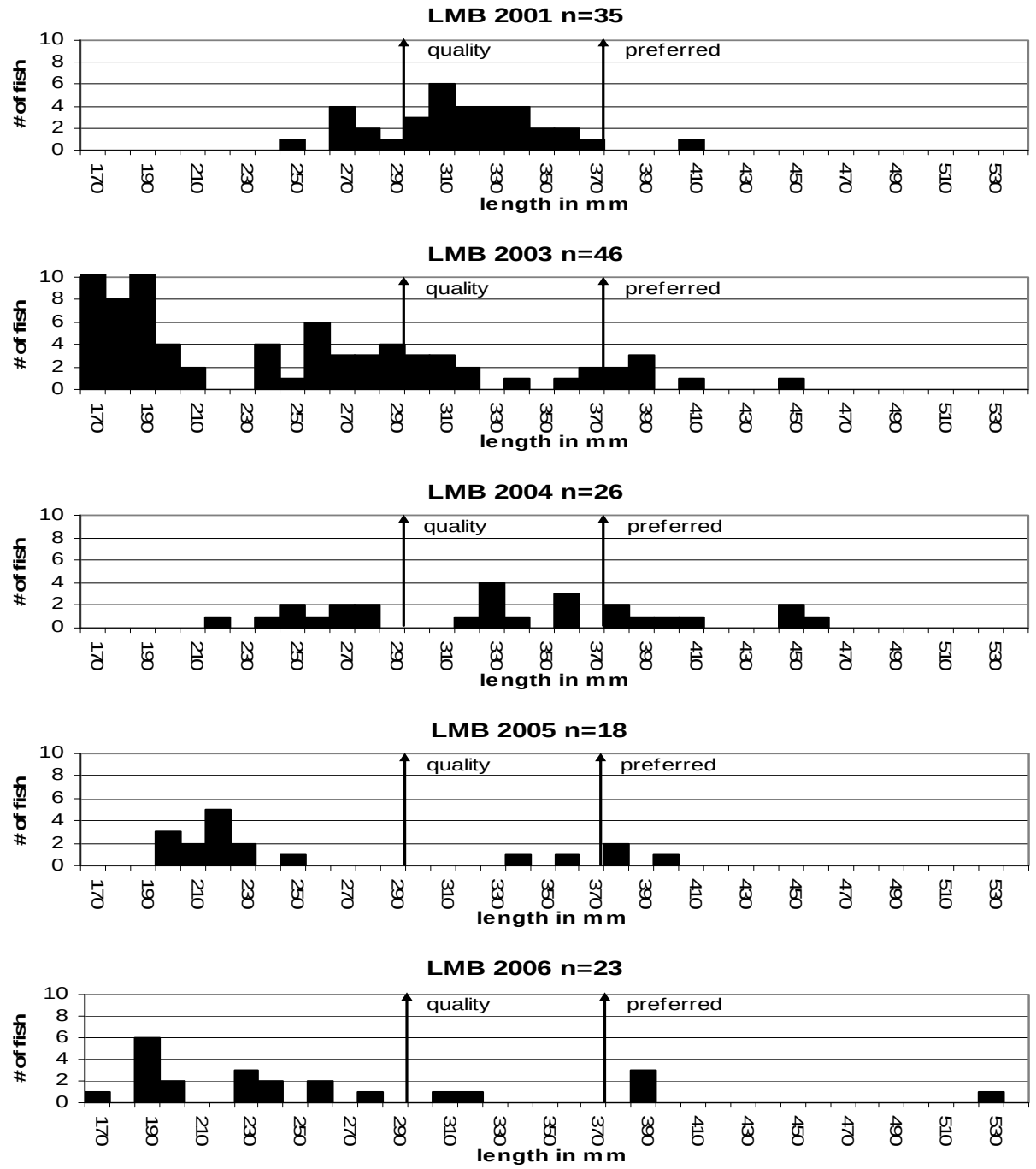


Figure 3. Length frequency histogram for largemouth bass over stock length in Curlew from 2000-2006.

Walleye

In the 2006 lake survey, gill net CPUE for walleye was 1.5 (Table 2). In 2003, 2,174 ten inch fingerlings were stocked (Appendix A). In hopes of establishing quality panfish and walleye fisheries at Curlew, a 14 inch minimum on walleye was put in effect January 1, 2004 to improve walleye density. In the fall of 2004, another 1,956 large fingerling walleye were stocked. Even with the 4,000+ fingerlings stocked in the past three years, walleye density continued to be low with a gillnet CPUE at 1.5. Our management objectives are not being met with densities this low. Walleye may be more of a bonus fish instead of a primary fishery as densities remain low inspite of intense stockings. Possibly low water conditions are affecting sampling or walleye survival.

Electrofishing CPUE for walleye greater than stock length was 14.5 fish per hour which is very similar to last year's 16.2 (Table 8). Stock indices were higher with a PSD of 63 and an RSD-P of 50 compared to 23 and 0 last year, respectively. Fish condition was good with Wr for stock length and larger fish of 93.2. At this time Curlew is scheduled to be stocked with large fingerlings every other year or as they are available.

Table 8. Total catch (N), catch per hour of electrofishing (CPUE), catch per hour of stock length and larger (CPUE-S), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) walleye collected by electrofishing in Curlew Lake, 2004-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
2004	21	19.5 (10.6)	17.9 (9.9)	21 (17)	0 (--)	89.0 (1.6)
2005	13	16.2 (9.4)	16.2 (9.4)	23 (22)	0 (--)	92.4 (2.4)
2006	10	17.5 (11.6)	14.5 (13.7)	63 (34)	50 (36)	93.2 (3.5)

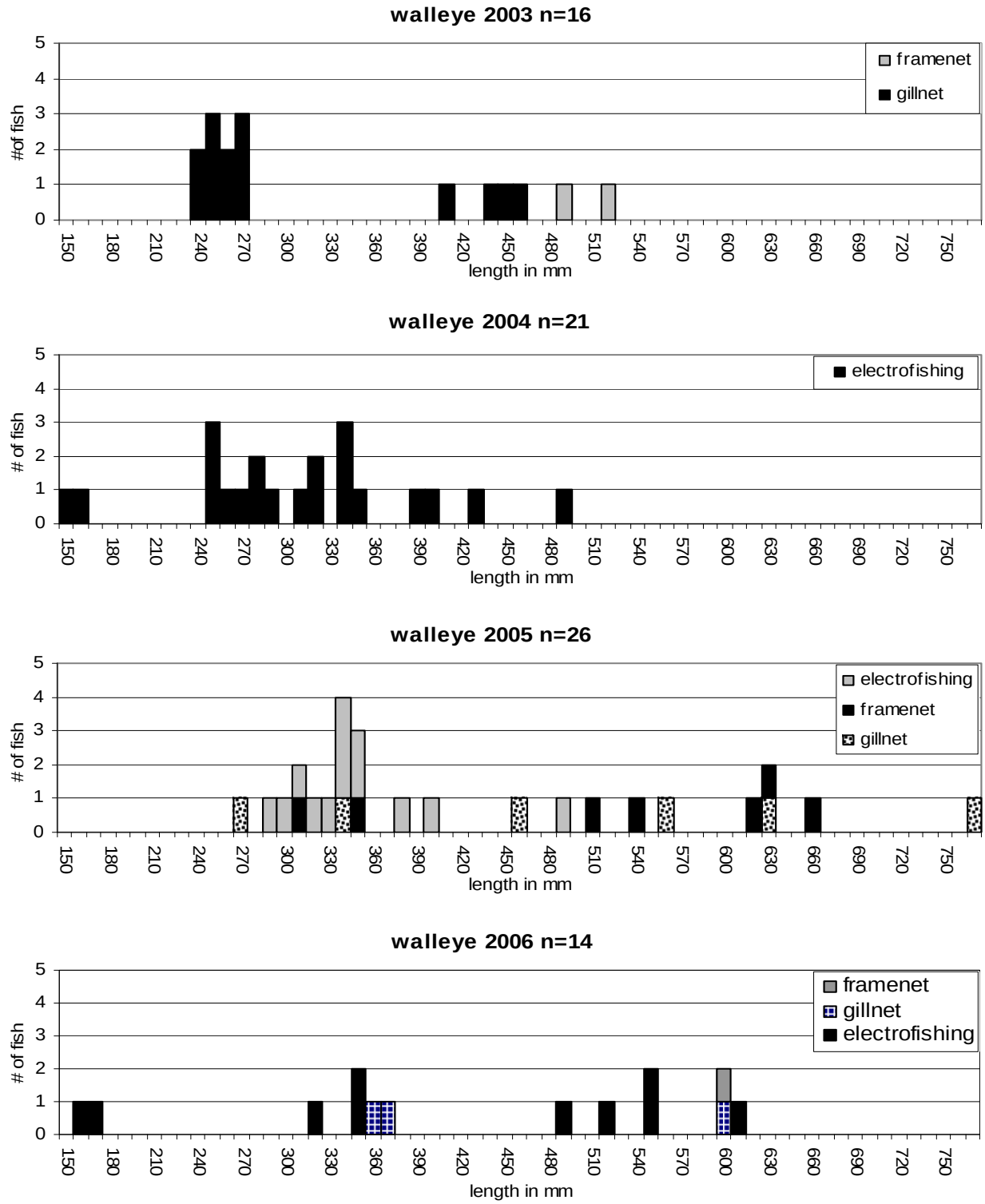


Figure 4. Length frequency for walleye from gillnet, frame net and electrofishing catch in Curlew Lake, 2003-2006.

Yellow Perch

Perch density has decreased since 2003 when 53 perch were sampled in the gill nets (Table 11). This survey 9 perch were sampled, compared to twelve last year. Stock indices yielded a PSD of 11 and a RSD-P of 11, compared to 45 and 0 last survey, respectively. Fish condition was average with a Wr for stock length and greater fish of 85.8. Length frequency shows some recruitment with fish in the 120 mm range (Figure 5).

Table 11. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for yellow perch collected from two, 150-ft experimental sinking gill nets in Curlew Lake, 2003-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
2003	53	26.5 (20)	25.5 (16.9)	2 (3)	0 (--)	83.8 (0.5)
2005	12	6.0 (3.1)	5.5 (1.5)	45 (29)	0 (--)	101.2 (2.4)
2006	9	4.5 (1.5)	4.5 (1.5)	11 (21)	11 (21)	85.8 (3.9)

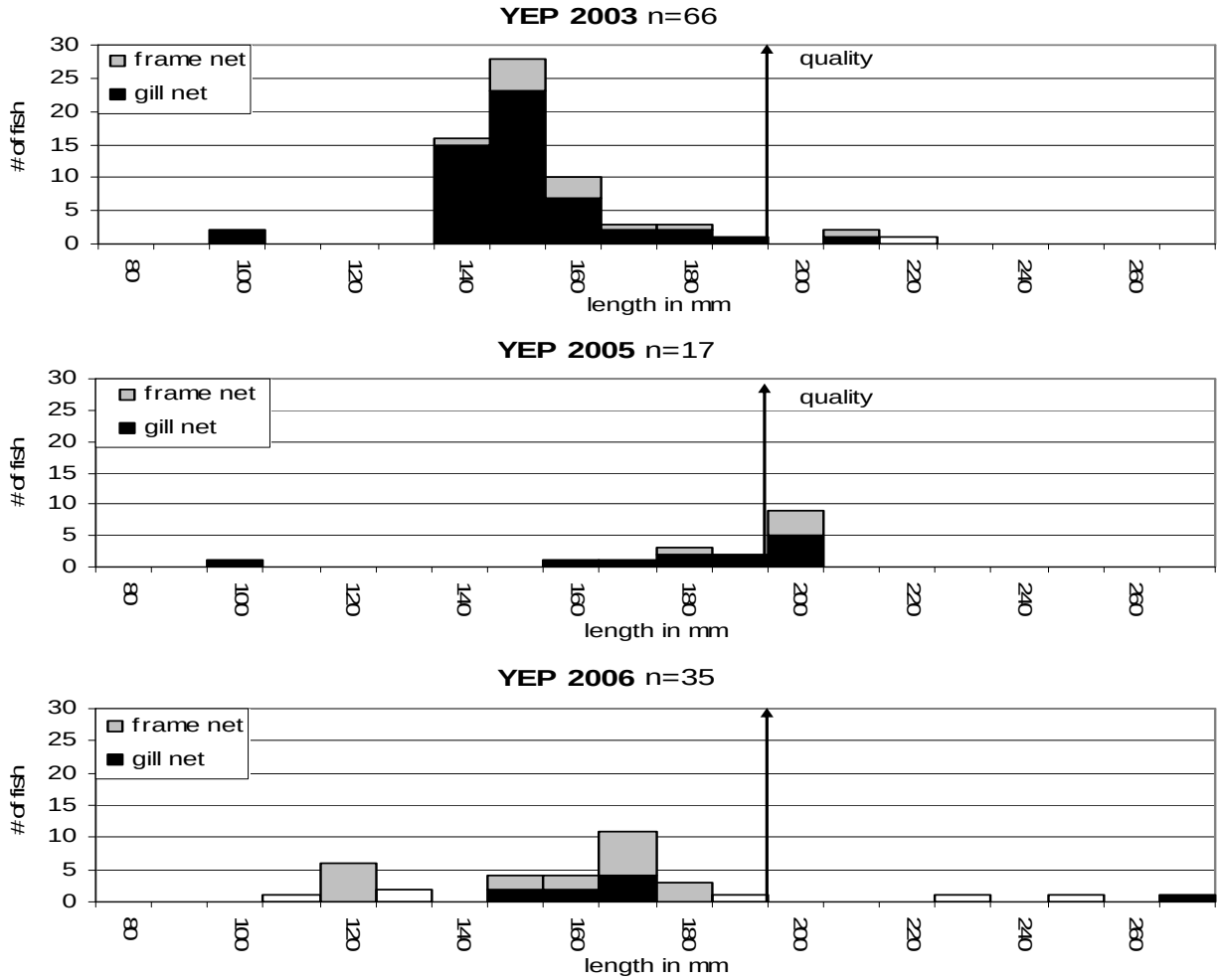


Figure 5. Length frequency for yellow perch from gillnet and framenet catch from 2003-2006.

Other fish species

Northern pike are the other fish suffering from low water in Curlew, and remain low in numbers with a gillnet CPUE of 2.5 (Table 2) and frame net CPUE of 0.1 (Table 1). In 2003, their numbers were 4.0 and 0.2, respectively. One species present but not sampled were bluegill. Anglers frequently catch bluegill and they can also be seen swimming along the shoreline. In 2003, framenet CPUE was 3.0.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., B.R. Murphy, and C.S. Guy. 1993. Stock density indices: development, use, and limitations. Reviews in Fisheries Science 1(3):203-222.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue to stock large walleye fingerling every other year as a second predator.

2. Electrofish annually to get better data sets on walleye and largemouth bass.

3. Survey panfish populations every other year to document effects of the new management strategies, if crappie don't respond, consider a minimum length on largemouth bass to further manage Curlew as a high quality panfish lake.

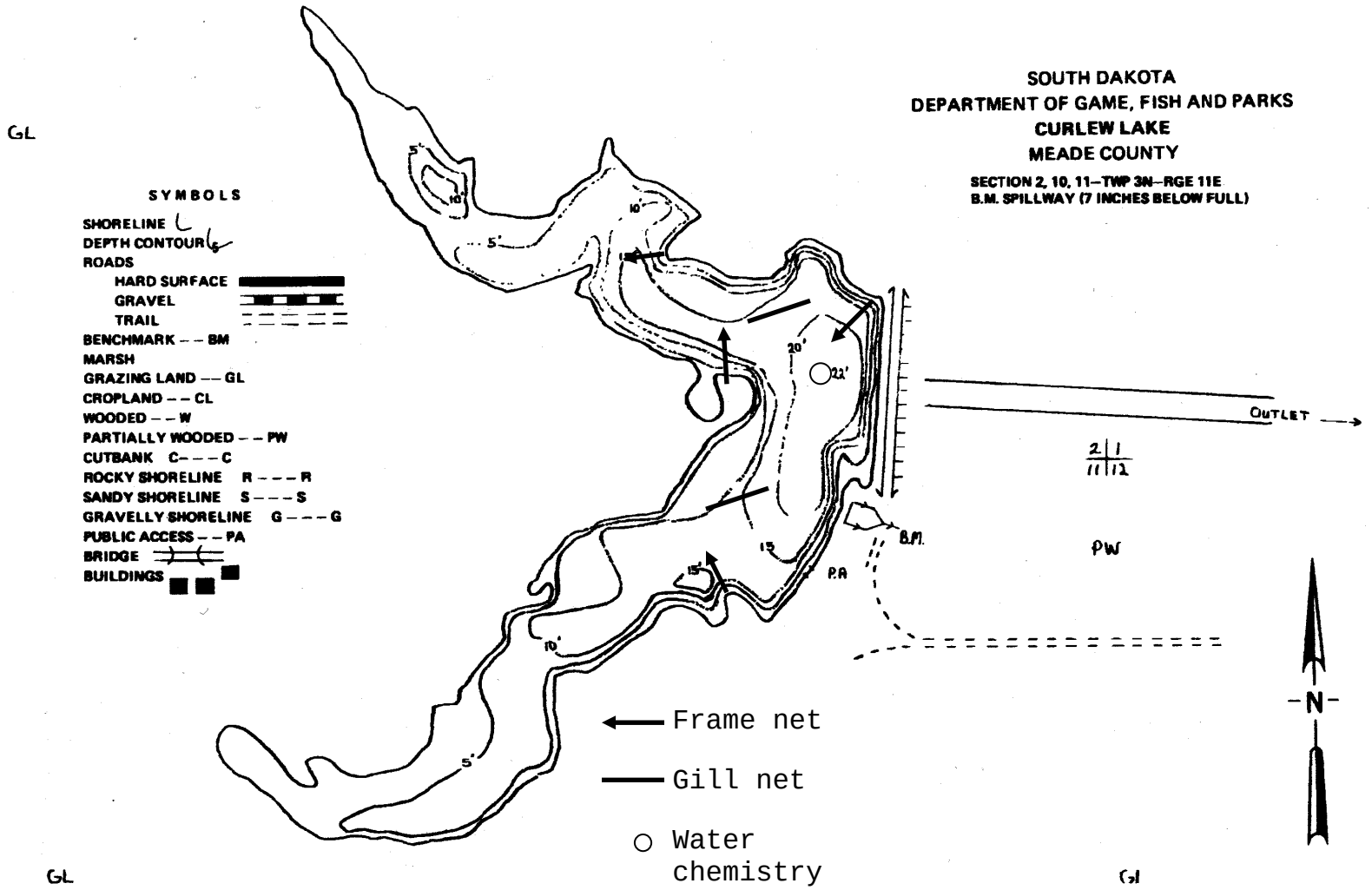
APPENDICES

Appendix A. Stocking record for Curlew Lake, Meade County, 1989-2006.

Year	Number	Species	Size
1989	1,500	Walleye	Fingerling
1990	15,480	Largemouth bass	Fingerling
1991	14,000	Largemouth bass	Fingerling
1992	13,600	Largemouth bass	Fingerling
	14,000	Walleye	Fingerling
1993	14,000	Walleye	Fingerling
2001	10,920	Largemouth bass	Fingerling
	4,760	Walleye	Fingerling
2002	13,600	Largemouth bass	Fingerling
2003	2,174	Walleye	Lg. Fingerling
2004	1,956	Walleye	Lg. Fingerling

Appendix B. Water chemistry results from site A on Curlew Lake, August 31, 2006.

Depth (ft)	Temp (^{o}C)	D.O. (mg/l)	pH	Conductivity (*u*mhos/cm)	Secchi disk (ft)
Surface	18.1	9.9	8.6		
2.3	19.0	9.1	8.9		
3.9	19.0	9.0	8.9		
6.5	19.0	8.9	9.0		
8.6	19.0	8.9	9.0		
10.7	19.0	8.9	9.0		
11.2	19.0	8.8	8.9		



Appendix C. Map of Curlew Lake sampling sites

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Deerfield Reservoir County: Pennington
Legal description: Sec. 25,R2E,T1N and Sec 19, 20, 29, 30, 32,R3E,T1N
Location from nearest town: 12 miles northwest of Hill City, South Dakota
Dates of present survey: 24 August 2006
Date last surveyed: 30 August 2005
Most recent lake management plan: F21-R-28 Date: 1994
Management classification: Coldwater Permanent
Contour mapped: 1987

Primary Species: (game and forage)
1. Hatchery rainbow trout
2. Splake trout
3. Lake chub

Secondary and other species:
1. White sucker
2. Golden shiner
3. Rock bass
4. Yellow perch

PHYSICAL CHARACTERISTICS

Surface Area: 435 acres; Watershed: 60,800 acres
Maximum depth: 29 m (95 ft.); Mean depth: 10.7 m (35 ft.)
Lake elevation at survey (from known benchmark): 80 % full

1. Describe ownership of lake and adjacent lakeshore property:

The Bureau of Reclamation maintains and operates Deerfield Reservoir and dam. The United States Forest Service (USFS) maintains and operates the campground and boat launch facilities at Deerfield Reservoir.

2. Describe watershed condition and land use:

The Deerfield watershed consists of approximately 95 square miles of forested land located within the Black Hills National Forest. The USFS has management authority on approximately 75% of the watershed and the remaining 25% is controlled by private landowners. A small portion of the privately owned land is cultivated and most of the remaining private land is open meadowland used for grazing or haying interspersed with coniferous forest.

3. Describe aquatic vegetative condition:

Vegetation density in most of the reservoir is low. In the shallow ends of most bays and at the inlet of Castle Creek and Gold Run Creek, small concentrations of heavy vegetation were present.

4. Describe pollution problems:

Minor pollution occurs from silt and nutrients washing into Deerfield Reservoir from Castle/Ditch Creek and Gold Run Creek as well as other smaller drainages flowing into the lake. Cattle grazing on the entire watershed, a limited amount of agricultural tillage, and cattle feeding contribute to siltation and nutrient loads. Silt deposits and weed growth in the upper portions of bays reflects these activities.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

The dam and spillway were reconstructed in 1986. A new valve at the outlet of Deerfield Lake was installed in December of 1995 allowing more precise control of flows into Castle Creek, which improved habitat for trout in the stream. The USFS is responsible for management and repair of boat ramps at Deerfield Lake. The south boat launch was renovated with concrete blocks in 2005. The north boat ramp is in need of repair. Both ramps were not usable due to low water conditions for most of the year.

CHEMICAL DATA

Water chemistry was conducted at Site A in Deerfield Reservoir on 30 June and 27 July 2006 by the DENR (Table 1). Oxygen was present to 70+ feet in late June, but oxygen was insufficient at 50+ feet for trout in late July.

Table 1. Water quality data from site A at Deerfield Reservoir, Pennington County, South Dakota collected on 30 June and 27 July 2006.

Date	Depth (ft.)	Temp (^{o}C)	D. O. (ppm)	pH	Conductivity (µS)
30-Jun-06	7.0	19.4	10.9		364
30-Jun-06	13.2	19.2	10.8		364
30-Jun-06	20.1	13.9	13.1		376
30-Jun-06	26.3	11.3	11.9		378
30-Jun-06	33.3	9.6	9.3		383
30-Jun-06	39.7	8.8	8.2		385
30-Jun-06	47.0	8.0	6.9		385
30-Jun-06	53.9	7.3	5.1		386
30-Jun-06	58.9	7.1	4.8		386
30-Jun-06	73.5	7.0	4.2		387
27-Jul-06	10.0	21.2	8.8	8.7	348
27-Jul-06	16.9	21.2	8.8	8.7	348
27-Jul-06	24.0	15.2	10.7	8.5	373
27-Jul-06	30.5	11.8	8.7	8.3	374
27-Jul-06	37.4	9.9	6.0	8.1	375
27-Jul-06	43.3	9.0	4.4	8.0	375
27-Jul-06	50.3	8.0	2.3	7.8	377
27-Jul-06	62.4	7.5	0.3	7.7	377

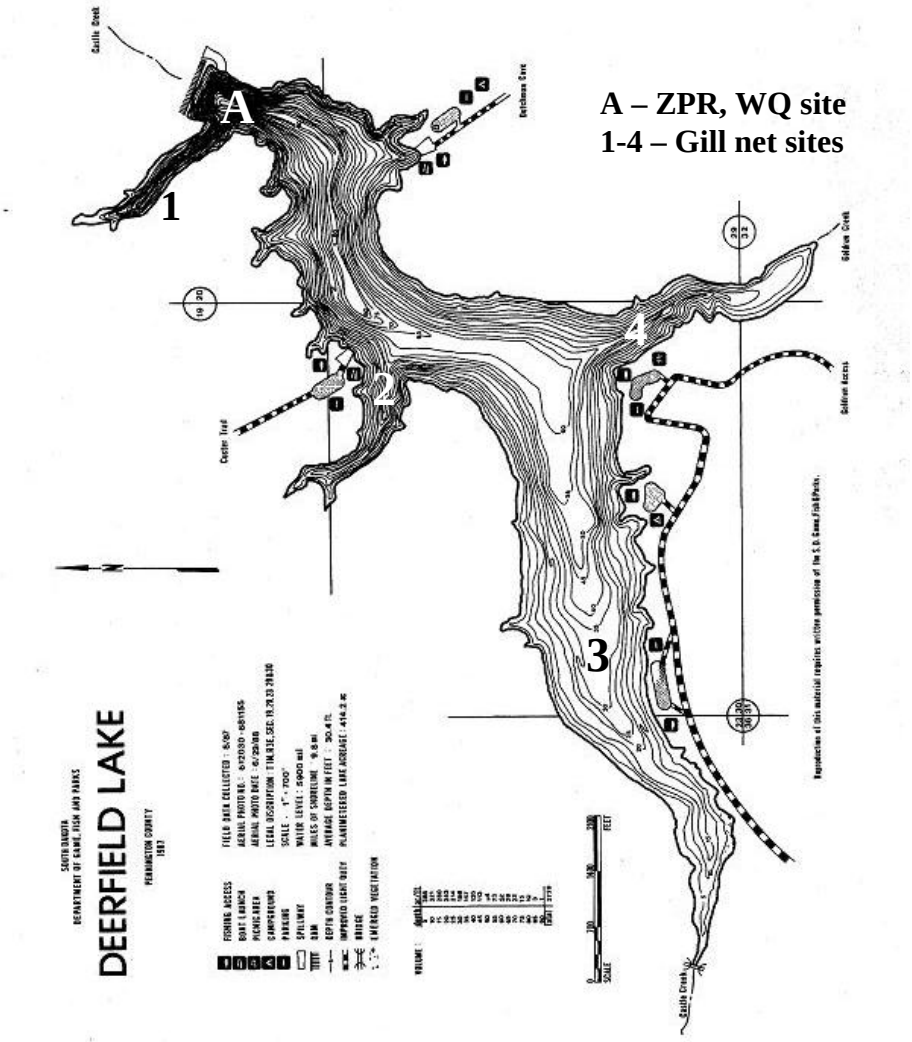


Figure 1. Lake map and sampling site locations for Deerfield Reservoir, Pennington County, South Dakota.

BIOLOGICAL DATA

Sampling in 2005 consisted of 4 gill net nights (Figure 1). Gill nets were set in previously established sites on 23 August 2006. Each net was a monofilament, experimental net that was 45.7 m (150-ft.) long and 1.8 m (6-ft.) deep with six 7.6 m (25-ft.) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Collected fish were measured for total length (mm) and weighed (g). All data was entered into WinFin 3.42 (Francis 1999).

Fish population parameters, confidence intervals, and standard errors were computed using WinFin Analysis (Francis 2000). Abundance is expressed as the mean CPUE (mean number per net night).

The ZPR was measured twice monthly from June through August and once in September (see The Zooplankton Ratio for Use in the Black Hills Put-Grow-and-Take Fisheries report, December 2004 for explanation of ZPR).

RESULTS AND DISCUSSION

Tables 2 and 3 report the Wr, CPUE, and the total number of fish caught in gill nets in 2006.

Table 2. Mean Wr and total catch of four 150 ft. experimental, sinking, monofilament gill nets at Deerfield Reservoir, Pennington County, South Dakota on 24 August 2006.

Species	Total Caught	%	Mean Wr	PSD	RSD-P
H. rainbow trout	77	17.5	74.2	--	--
Lake chub	1	0.3	--	--	--
Rock bass	147	33.4	--	0	0
Splake trout*	78	17.7	79.2	--	--
White sucker	103	23.4	89.3	94	90
Golden Shiner	3	0.7	--	--	--
Yellow perch	31	7.0	88.4	35	0
Totals	**440**	**100**			

*All trout with splake/brook trout traits were classified as splake.

Table 3. Comparison of CPUE for species collected from gill nets from 2000 through 2006 at Deerfield Reservoir, Pennington County, South Dakota.

Species	2000	2001	2002	2003	2004	2005	2006
H. rainbow trout	21.8	16.5	22.1	14.3	21.5	16.0	19.3
Lake chub	2.8	1.5	0.6	0.8	0.3	0.5	0.3
Rock bass	1.0	3.3	3.9	4.8	7.5	28.3	36.8
Splake trout*	17.3	29.5	5.4	3.3	11.0	6.5	19.5
White sucker	52.8	54.5	22.3	26.8	36.3	35.0	25.8
Yellow perch	1.0	2.8	7.3	3.0	0.5	6.0	7.8

*All trout with splake/brook trout traits were classified as splake.

Rainbow Trout

Seventy-seven rainbow trout were sampled from gill nets in 2006. The rainbow trout CPUE was 19.3, which is above the past 6 year average of 18.7 (Figure 2), even though fewer trout have been stocked recently. The rainbow trout quality (Wr) had been declining for several years, increased in 2004, and is now similar to that of 2004 at 74.2 (Figure 2). The length frequency histograms suggest that rainbows are growing slightly larger than previous years (Figure 3). Also, it was noted during surveys that several rainbows appeared to be naturally reproduced. The length frequency graph also indicates this as no small rainbow trout were stocked into Deerfield in 2006. If these are indeed natural rainbows, they likely originated from apparent reproduction in Castle Creek above Deerfield Reservoir.

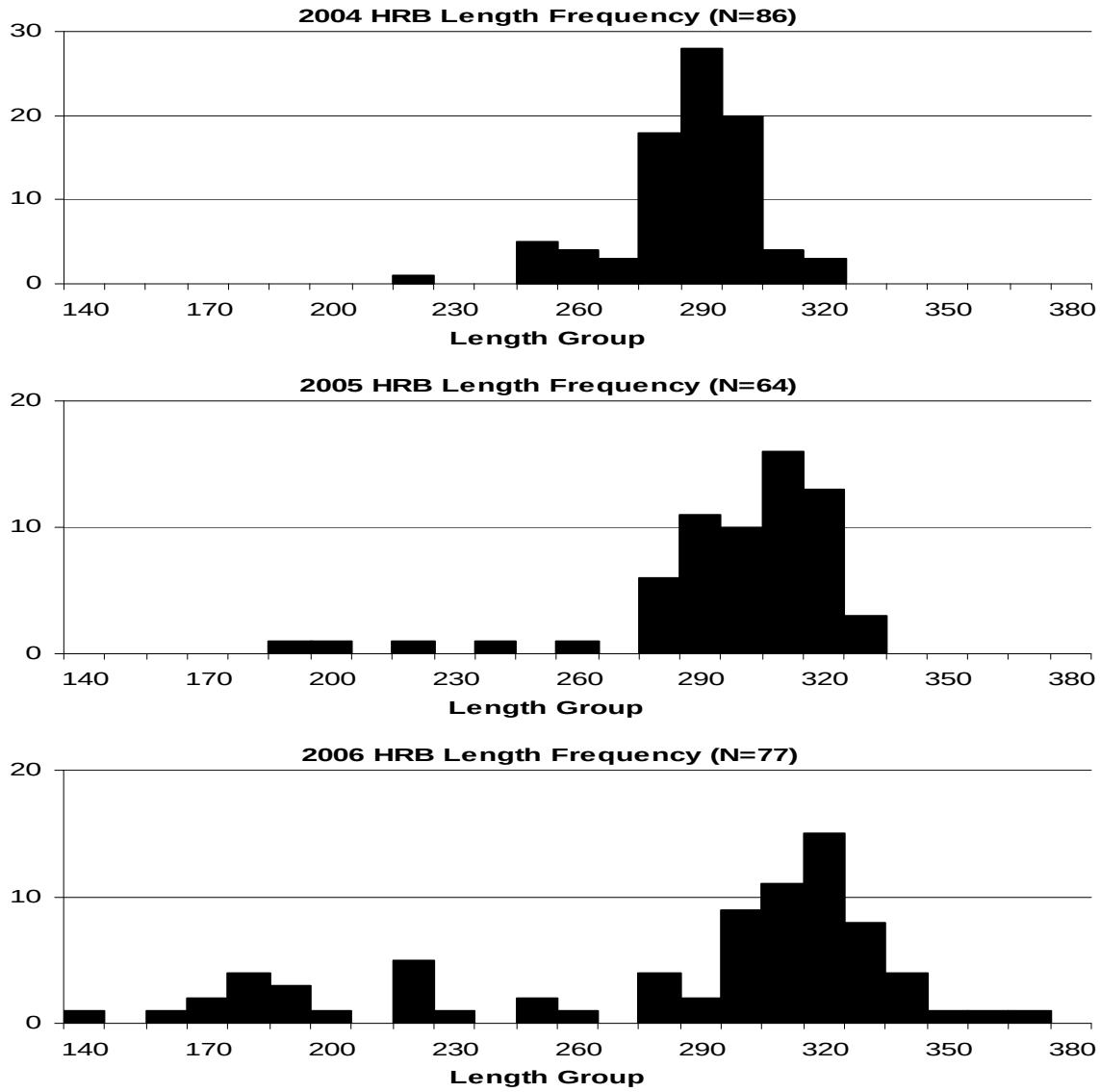


Figure 3. Length frequency histograms for rainbow trout collected in gill nets from Deerfield Reservoir, Pennington County, South Dakota.

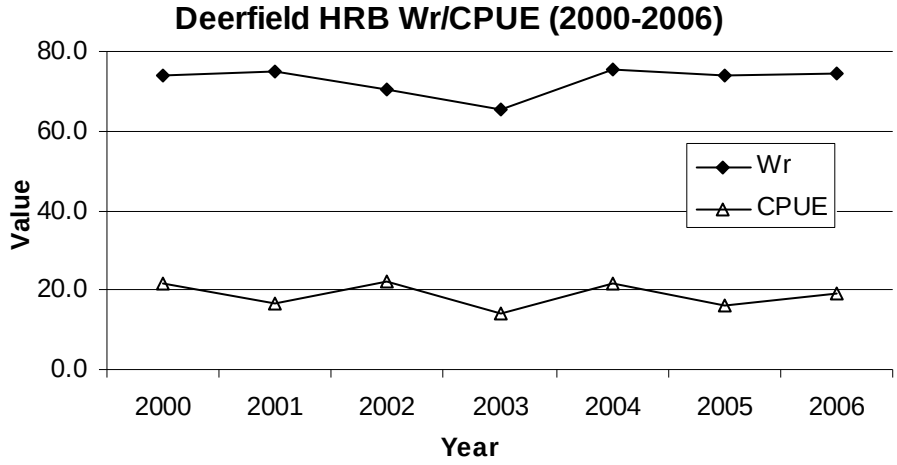


Figure 2. CPUE and Wr for hatchery rainbow trout collected from gill nets set in Deerfield Reservoir, Pennington County, South Dakota.

Splake Trout

Catchable splake trout were stocked for the first time in Deerfield in the spring of 2006. Their overall CPUE was 19.5 (Figure 4). The catch rate for stocked splake (determined by adipose clip) was 4.5 and for unclipped splake was 15.0. Overall Wr was 79.2, a slight increase over last year. Stocked splake had a low Wr of 68.8. The length frequency histograms suggest that unstocked splake are about the same size as the previous two years (Figure 5). The larger splake sampled in Deerfield in 2006 are composed of the stocked splake.

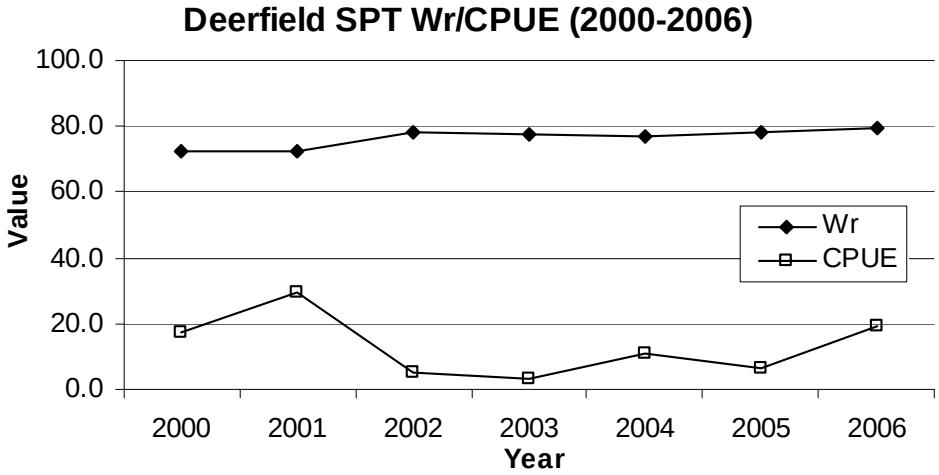


Figure 4. CPUE and Wr for splake trout collected from gill nets set in Deerfield Reservoir, Pennington County, South Dakota.

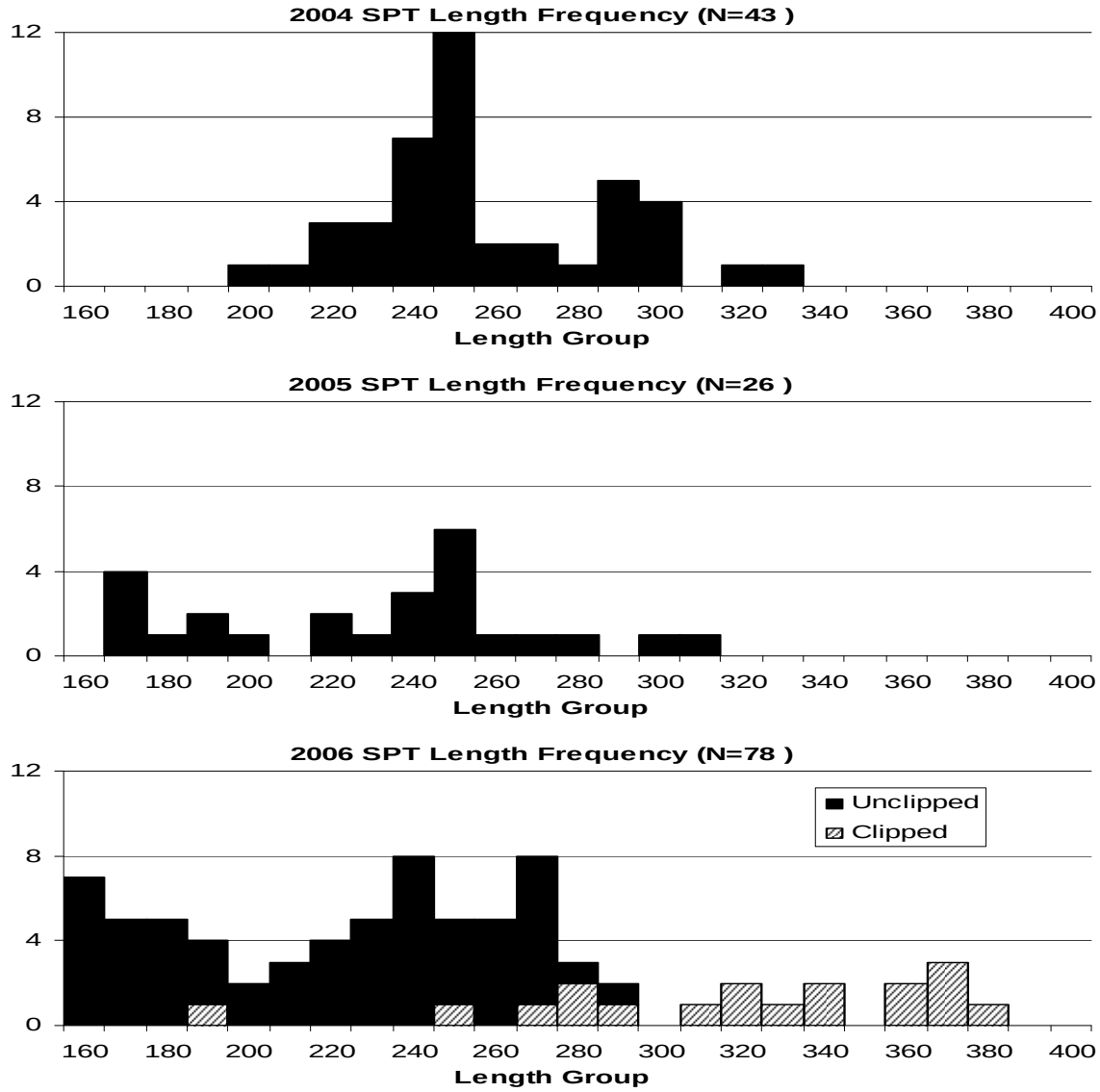


Figure 5. Length frequency histograms for splake trout collected in gill nets from Deerfield Reservoir, Pennington County, South Dakota. Stocked splake are indicated by striped bars.

White Suckers

White suckers were first sampled in 1993 after a 1982 chemical renovation. Due to the increasing number of white suckers collected during lake surveys at Deerfield, a white sucker removal program was conducted from 1999 to 2001. Frame nets with ¾ inch mesh were used to catch white suckers during their spawning period and then removed from Deerfield in an attempt to reduce the overall number of white suckers in the lake and prevent some reproduction. Due to the large number of suckers removed, the field crew felt there would be an impact. From 2000-2002, a decline in the CPUE of white suckers occurred, but an

increase in CPUE was observed in 2003 and again in 2004 (Figure 6). We initiated the sucker removal program again in 2006. Over 7 tons of suckers were removed (Table 4). The CPUE was 10 units lower in 2006 compared to 2005 suggesting a small impact may have been made (Figure 6). The length frequencies also suggest a small impact may have occurred indicated by the small size group compared with previous years (Figure 7).

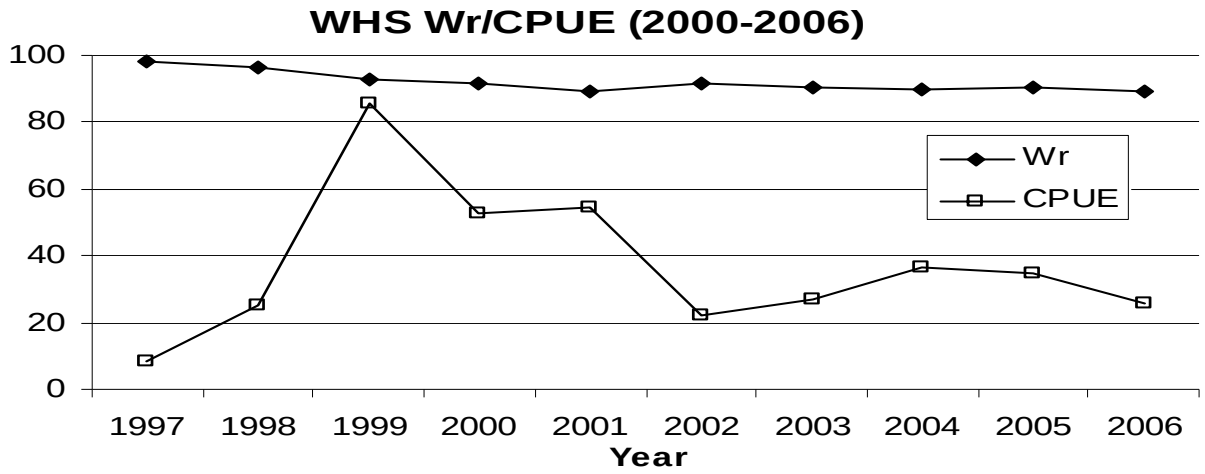


Figure 6. CPUE and Wr for white suckers collected from gill nets set in Deerfield Reservoir, Pennington County, South Dakota.

Table 4. Summary of white suckers removed by trap nets from Deerfield Reservoir, Pennington County, South Dakota.

Year	N Removed	Pounds Removed	Mean Weight (lbs)
1999	3,136	4,504	1.4
2000	9,571	13,400	1.4
2001	4,355	5,401	1.2
2006	9,020	14,432	1.6

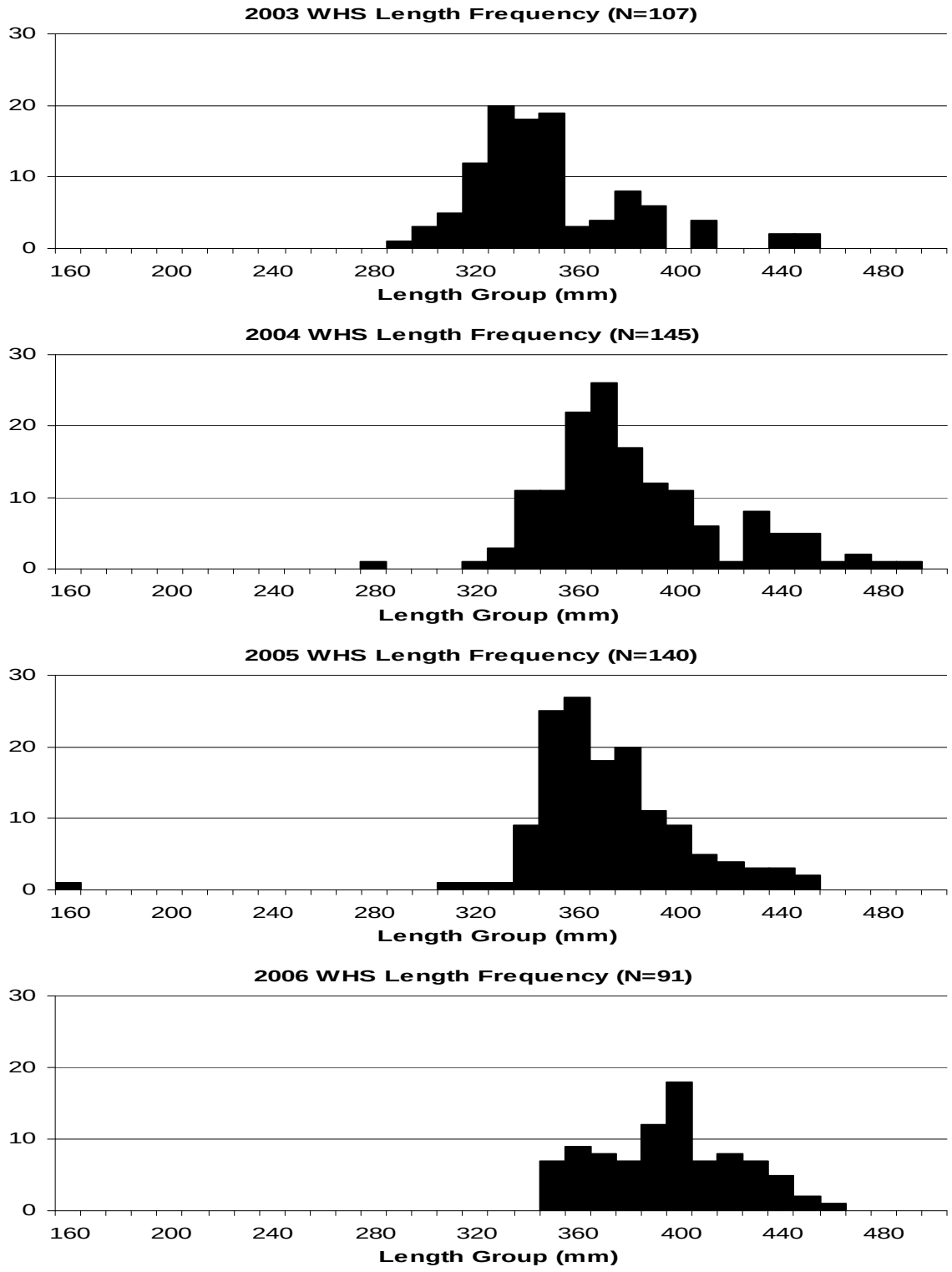


Figure 7. Length frequency histograms for white suckers collected in gill nets from Deerfield Reservoir, Pennington County, South Dakota.

Other Species

Lake chub numbers declined substantially in 2000 and continue to remain low (Tables 2 and 3). Yellow perch numbers have been quite variable since that time; 31 were caught in 2006. Rock bass numbers were much higher in 2005 (CPUE of 28.3 compared to a past 6 year mean of 3.7) and even higher this year (CPUE - 36.8).

ZPR

The zooplankton ratio (ZPR) data for Deerfield Reservoir is presented in Figure 8. The ZPR was an experimental sampling to attempt to relate zooplankton abundance and size structure to rainbow trout growth and condition. The results of the sampling have been unclear. The mean ZPR (750:153) at site A in 2004 was 0.054 and the mean zooplanktor length was 1.08 mm. In 2005, the values were 0.21 and 1.33 mm. In 2006, the values were 0.19 and 1.37. Similar to last year, an increase in trout Wr was not observed as anticipated. Competition among white suckers and other species may be limiting the increase in the trout Wr's.

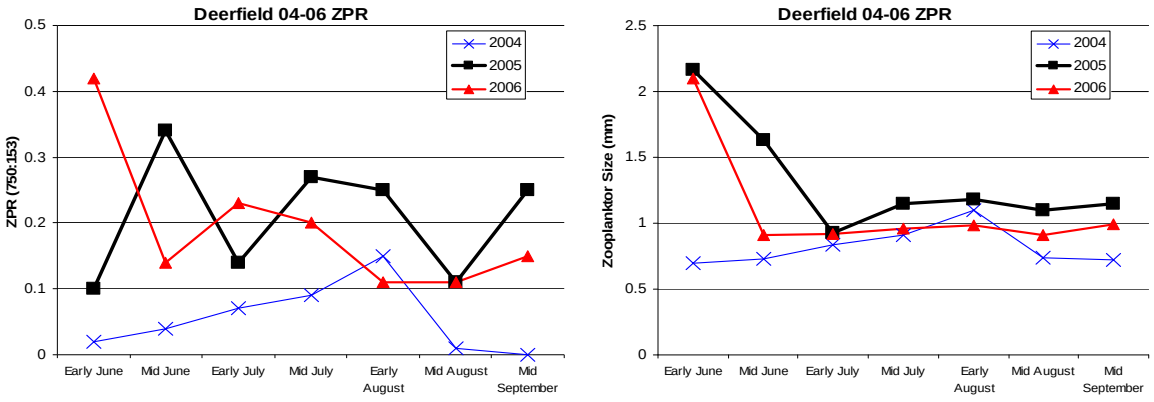


Figure 8. ZPR (750:150) and mean zooplanktor size at Deerfield Reservoir, Pennington County, South Dakota.

LITERATURE CITED

Francis, J. 1999. WinFin, Version 3.42; Microsoft Access Program for data entry. Nebraska Game and Fish Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.7. Nebraska Game and Fish Commission, Lincoln.

RECOMMENDATIONS

1. Stock catchable rainbows.

2. Complete a standard lake survey during summer 2007.

3. Splake trout were stocked in the spring of 2006. These fish need to be critically evaluated to monitor success of the stocking and its intended purpose of reducing white sucker recruitment.

4. Continue white sucker removal program in the spring of 2007.

APPENDICES

Appendix 1. Stocking record for Deerfield Reservoir, Pennington County, South Dakota 1996 through 2006.

Year	Number	Species	Size
1996	120,000	rainbow trout	fingerling
	800	rainbow trout	fingerling
	26,680	splake trout	fingerling
1997	119,985	rainbow trout	fingerling
	750	rainbow trout	adult
1998	112,862	rainbow trout	fingerling
	6,700	rainbow trout	fingerling
	1,908	rainbow trout	catchables
1999	120,000	rainbow trout	fingerling
	2,538	rainbow trout	catchables
	23,373	splake trout	fingerling
2000	120,000	rainbow trout	fingerling
	2,125	rainbow trout	catchables
	210	rainbow trout	adult
2001	60,612	rainbow trout	fingerling
	7,219	rainbow trout	catchables
2002	60,000	rainbow trout	fingerlings
	10,164	rainbow trout	catchables
	307	rainbow trout	adult
2003	350	rainbow trout	adult
	8,409	rainbow trout	catchables
	60,625	rainbow trout	fingerlings
2004	10	rainbow trout	adult
	12,000	rainbow trout	catchables
2004	10	rainbow trout	adult
	12,000	rainbow trout	catchables
2005	12,000	rainbow trout	catchables
2006	12,124	rainbow trout	catchables

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: New Underwood Dam County: Pennington
Legal description: NM ¼ Sec 30, T2N, R11E
Location from nearest town: ½ mile N, ½ mile W of New Underwood, SD
Dates of present survey: May 11, 2006
Date last surveyed: September 21, 2004
Most recent lake management plan: F21-R-28 Date: 1994
Management classification: Warmwater semi-permanent
Contour mapped: N/A

Primary Species:(game and forage)	Secondary and other species:
1. Black crappie	1. Black bullhead
2. Bluegill	2. Golden shiner
3. Largemouth bass	3. Channel catfish

PHYSICAL CHARACTERISTICS

Surface Area: 20 acres; Watershed: 1,920 acres
Lake elevation at survey (from known benchmark): -3 feet

1. Describe ownership of lake and adjacent lakeshore property:

The lakeshore is owned by the South Dakota Department of Game, Fish and Parks and managed as a lake access area.

2. Describe watershed condition and percentages of land use:

The watershed is privately owned, except for the immediate lakeshore. Most of the area is planted with small grain crops.

3. Describe aquatic vegetative condition:

Cattails surround much of the lake. Submerged vegetation can be troublesome in mid to late summer and is found in water less than 6 feet.

4. Describe pollution problems:

Siltation is decreasing depth and leading to increased amounts of emergent and submergent aquatic vegetation. No other pollution problems were identified by department personnel during the 2005 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All structures associated with New Underwood dam appeared to be in good condition. No problems were identified by department personnel.

BIOLOGICAL DATA

Methods

Electrofishing

Night electrofishing was conducted at New Underwood on May 11, 2006. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. Two, 10-minute sights were completed during the survey. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95 (Francis 1999).

Data Analysis

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

New Underwood Dam is an important public water body in Eastern Pennington County and is located only 20 miles from Rapid City. Currently, largemouth bass, bluegill, and black crappie are managed as the primary game fish in New Wall Dam while channel catfish are managed as secondary game fish. A 15-inch (381-mm) minimum length limit had been imposed on largemouth bass since 2004 in efforts to further improve panfish size structure.

Largemouth bass

During night electrofishing only largemouth bass were sought. Night electrofishing was done in the spring as fall electrofishing has been hampered by heavy weed growth. Extreme low water conditions reduced the amount of shoreline that could be sampled.

A total of 18 largemouth bass were captured during the 2006 spring night electrofishing (Table 1). Mean CPUE was 60.5 for all largemouth bass and CPUE for largemouth bass stock length and longer was also 60.5. For a recent comparison, 2004 CPUE for fall electrofishing were 117.5 and 99.0, respectively. Size structure was small with a PSD of 17, compared to 28 in 2004. Fish condition was excellent with a Wr of 104.1 for stock length and larger fish. This compares to 93.0 in 2004, but that's comparing spring sample to fall sample.

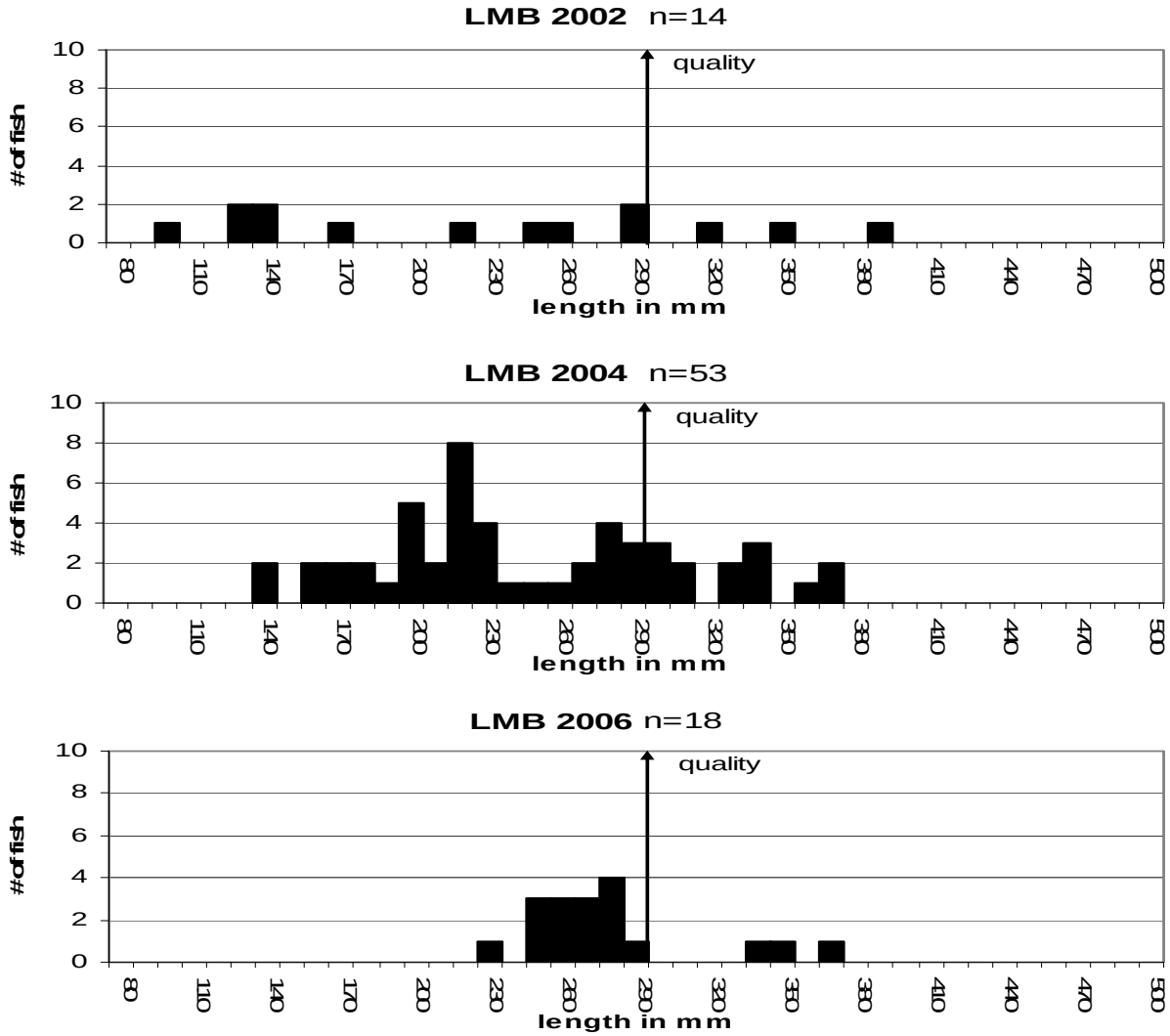


Figure 1. Length frequency histogram for Largemouth Bass at New Underwood Dam, 2002, 2004, 2006.

Table 1. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in New Underwood, 2002, 2004, 2006.

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
2002	14	1,195	42.9 (60.6)	24.4 (21.4)	38 (35)	13 (23)	94.4 (3.8)
2004	56	1,700	117.5 (56.9)	99.0 (27.7)	28 (11)	0 (--)	93.0 (1.8)
2006	18	1,067	60.5 (9.1)	60.5 (9.1)	17 (16)	0 (--)	104.1 (1.3)

LITERATURE CITED

Francis, J. 1999. WinFin: Version 2.95; Microsoft Access program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program, Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting lake surveys biannually to monitor bass and panfish populations and to evaluate the 15-inch minimum bass regulation.

2. Continue to stock channel catfish when available to provide a unique angling opportunity at this well-utilized fishery.

APPENDICES

Appendix A. Stocking record for New Underwood Dam, Pennington County, 1996-2006.

Year	Number	Species	Size
1996	2,500	Largemouth bass	Fingerling
1997	2,000	Largemouth bass	Fingerling
1998	268	Largemouth bass	Adult
1999	660	Largemouth bass	Fingerling
	100	Largemouth bass	Adult
2001	2,040	Largemouth bass	Fingerling
2002	2,680	Largemouth bass	Fingerling
2003	200	Largemouth bass	Adult
	30	Channel catfish	Adult
2004	336	Channel catfish	Adult
2006	217	Channel catfish	Adult

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: New Wall Lake County: Pennington
Legal description: T 1 S, R 15 E; Sec 1-2, 11-12
Location from nearest town: 1.5 mi. S and 1.5 mi. W of Wall, SD
Dates of present survey: June 20-22, 2006; October 18, 2006
Date last surveyed: June 24-26, 2002; September 11, 2002
Most recent lake management plan: F21-R-32 Date: 1998
Management classification: Warm water permanent
Contour mapped: Date 1985

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. White crappie
2. Bluegill	2. Black bullhead
3.	3. Yellow perch
4.	4. Northern Pike
5.	5. Walleye
6.	6. White sucker

PHYSICAL CHARACTERISTICS

Surface Area: 42 acres; Watershed: 3,780 acres
Maximum depth: 24 feet; Mean depth: 12.9 feet
Lake elevation at survey (from known benchmark): - 7 feet

1. Describe ownership of lake and adjacent lakeshore property:

New Wall Dam was built by and is maintained by the South Dakota Department of Game, Fish and Parks.

2. Describe watershed condition and percentages of land use:

The ownership of the watershed of New Wall Dam consists of: 10% state, 50% private, and 40% federal. Of the total 3,780 acres, 40% are agricultural (winter wheat) and 60% are short grass prairie.

3. Describe aquatic vegetative condition:

Low water has left some cattails out of the water, but on the steeper gradients some still enter the lake. Submergent vegetation is plentiful in the shallow, upper ends of the lake in water under five feet.

4. Describe pollution problems:

No pollution problems were identified by departmental personnel during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All structures associated with New Wall Dam are in good condition. The boat ramp is situated at the bottom of a steep hill and needs periodic maintenance.

CHEMICAL DATA

1. Describe general water quality characteristics.
Water chemistry was measured in the field on July 27 by the DENR. A water profile was taken at the deepest part on the lake. The results are in Appendix B.

2. Thermocline: Yes ___ No _X_; location from surface ___ m

3. Stations for water chemistry located on attached lake map: No

BIOLOGICAL DATA

Methods

A lake survey was conducted on New Wall June 20-22, 2006. Sampling consisted of 2 gill net nights and 8 trap net nights (Figure 2). All gill nets were monofilament experimental nets. Each net was 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at four stations consisting of 4 trap net nights each. All trap nets were modified fyke-nets with a 1.3 X 1.5-m frame, 19.1 mm (0.75 inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Night electrofishing was conducted at New Wall on October 18, 2006. Electrofishing was conducted using a Smith-Root unit with pulsed-DC. Three, 10-minute sights were completed during the survey. All largemouth bass were collected, measured for total length (TL; mm) and weighed (g). In addition, scale samples were collected from up to 5 fish per centimeter group for age and growth analysis. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE),

proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the Coffelt control box and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

New Wall Dam is an important public water body in Eastern Pennington County. Currently, largemouth bass and bluegill are managed as the primary game fish in New Wall Dam while white crappie and yellow perch are managed as secondary game fish. In efforts to improve bass size structure, a 12-inch to 16-inch slot with only one fish over 16 inches included in a daily limit of 5 has been implemented and took effect January 1, 2003. Size structure has improved, but density is at an all-time low. This is probably due to extreme drought conditions the last three years.

Fish Community Survey

Gillnet and Trapnet Survey

Overall, nine fish species were collected during the lake survey conducted June 24-26, 2002 in New Wall Dam (Table 3). Three hundred forty five fish were collected in frame nets, with bluegill comprising 35.6% of the total. White crappie were the second most abundant species in the frame nets with 31.3%. Yellow perch were the other plentiful species in the frame nets at 28.4%. Other species sampled, in order of abundance, were black crappie, golden shiner and black bullhead.

The gillnet catch was dominated by yellow perch, which comprised 64.8% of the total catch. Other species sampled in gillnets were white crappie, northern pike, golden shiner, largemouth bass and walleye. Population parameters of the dominant game fish species in New Wall Dam are discussed individually below.

Fall electrofishing survey

Seven, ten-minute stations of electrofishing captured 204 largemouth bass in 3,950 seconds of pedal time. Largemouth bass were the only fish sought from this survey, which is done annually because of the regulations imposed on New Wall Dam.

Table 1. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for fish species collected from eight ¾ inch trapnets in New Wall Dam, Pennington County, June 20-22, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Black bullhead	3	0.4 (0.4)	0.4 (0.4)	--	--	92.3 (16.0)
Black crappie	7	0.9 (0.6)	0.9 (0.6)	--	--	88.3 (2.5)
Bluegill	123	15.4 (6.4)	15.2 (6.3)	72 (7)	50 (7)	99.7 (5.0)
Golden shiner	6	0.8 (0.5)	0.8 (0.5)	--	--	--
White crappie	108	13.5 (4.7)	13.5 (4.7)	99 (1)	93 (5)	83.7 (0.5)
Yellow perch	98	12.3 (6.0)	11.5 (5.6)	25 (8)	5 (4)	90.3 (8.8)
total	345					

Table 2. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD-P; 90% CI's in parentheses), and condition factor (Wr for fish ≥ stock length; 80%CI's) for all fish species collected from two 150-ft experimental sinking gill nets in New Wall Dam, Pennington County, June 20-22, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr ≥ S
Golden shiner	9	4.5 (4.6)	--	--	--	--
Largemouth bass	1	0.5 (1.5)	0.5 (1.5)	--	--	105.4 (--)
Northern pike	12	6.0 (3.1)	6.0 (3.1)	83 (20)	8 (15)	101.7 (3.0)
Walleye	1	0.5 (1.5)	0.5 (1.5)	--	--	89.0 (--)
White crappie	20	10.0 (9.2)	10.0 (9.2)	--	--	91.7 (0.6)
Yellow perch	79	39.5 (16.9)	39.5 (16.9)	8 (5)	0 (--)	83.8 (0.5)
Total	122					

Bluegill

Bluegill were the most abundant species sampled, with a trap net CPUE of 15.4 (Table 1). Stock indicies were also strong with a PSD of 72 and a RSD-P of 50. These numbers would indicate that this population should provide an excellent bluegill fishery. During the last survey in 2002, CPUE was 30.6 with a PSD of 90 and a RSD-P of 9. Fish condition is excellent with a mean Wr for stock length and larger fish of 99.7. The length frequency histogram (Figure 1) indicates most fish are between 200 mm and 230 mm. Bluegill growth was slightly slower than the state average, requiring about four years to reach quality size (Table 3).

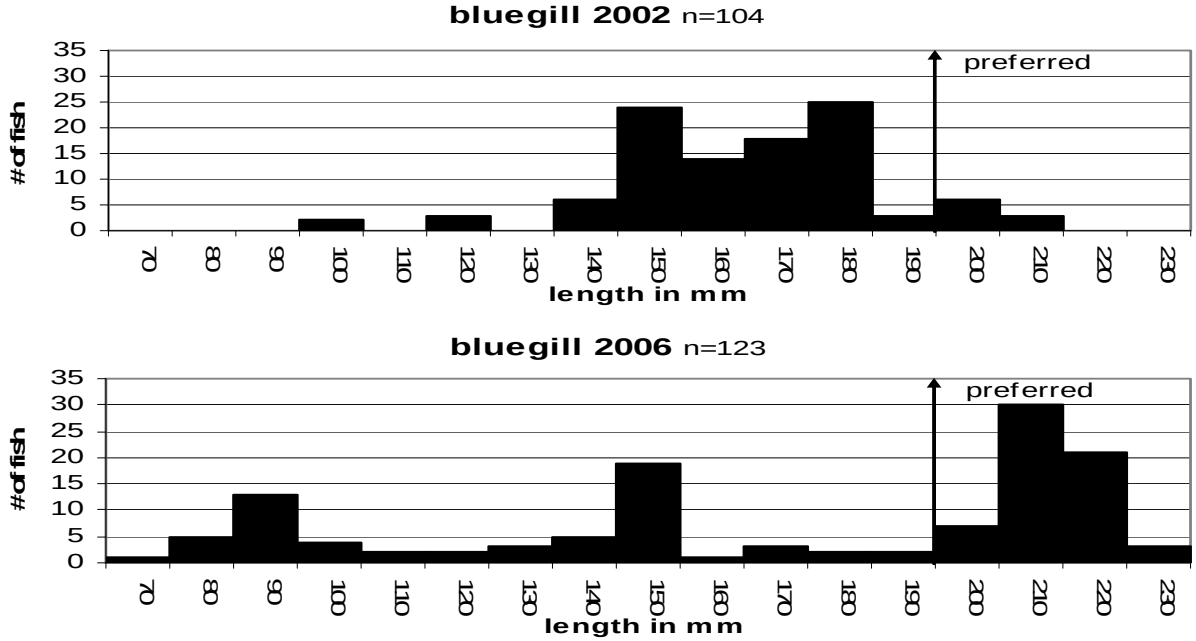


Figure 1. Length frequency histogram of bluegill collected by frame nets in New Wall Dam, June 2002 & 2006.

Table 3. New Wall Dam bluegill year class, age in 2006, sample size (N), mean back-calculated total length at age, population standard error (SE), and the South Dakota bluegill mean length at age (Willis et al. 2001).

Year Class	Age	N	Age 1	2	3	4	5	6	7	8
2000	2	2	44	91						
1999	3	27	35	75	139					
1998	4	3	40	85	135	174				
1995	7	7	37	74	112	135	162	182	200	
1994	8	51	32	57	96	130	146	171	195	215
Sample Size		90								
2002 Mean (SE)			**38 (2)**	**76 (6)**	**121 (10)**	**147 (14)**	**154 (8)**	**176 (6)**	**198 (3)**	**215 (0)**
South Dakota mean			55	103	141	166	180			

White crappie

As in the 2002 survey, the white crappie population was the second most abundant species in the frame nets. Last survey, CPUE was 12.6 with a PSD of 92 with an RSD-P of 33 (Table 1). This year, CPUE was 13.5 and size structure was incredible with a PSD of 99 and an RSD-P of 93. The length frequency histogram (Figure 2) showed most fish were between 250 mm and 300 mm. Crappie condition was low with a mean Wr ≥ stock length of 83.7. In 2002, the mean Wr was 87. This population is dominated by old, large crappie which should pass out of the system soon from natural mortality. It will be interesting to see how the other fish species respond when this group of predators disappears.

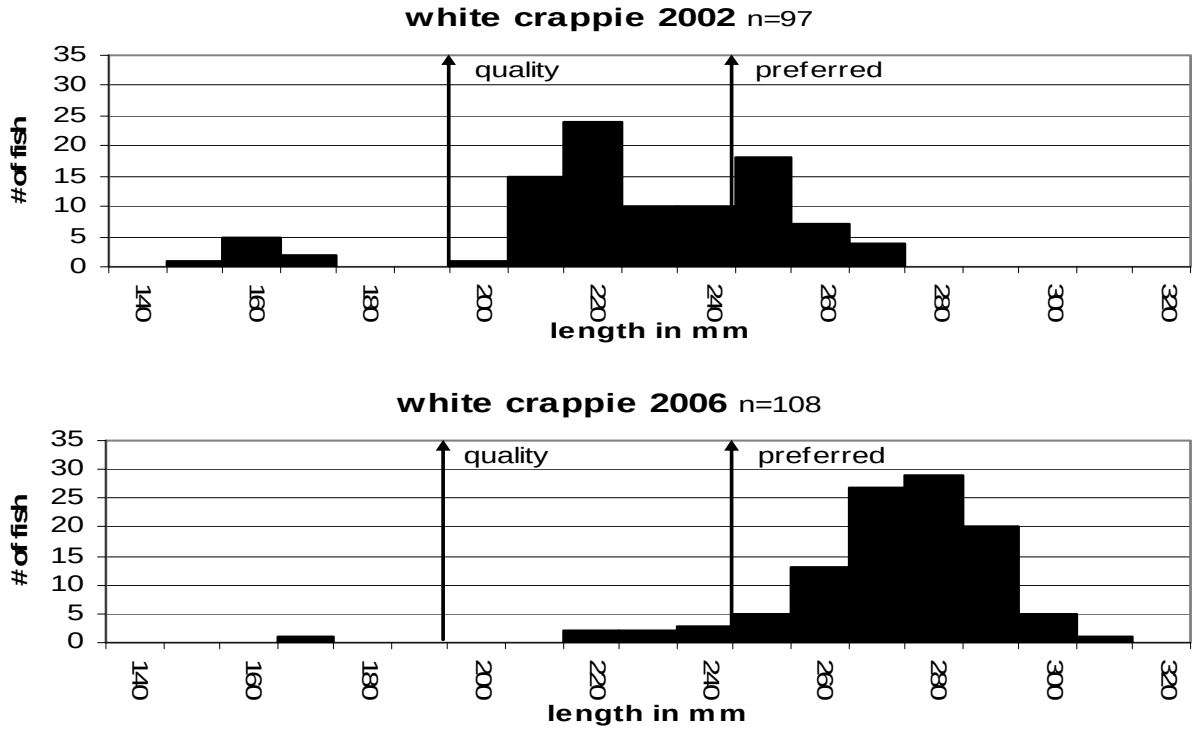


Figure 2. Length frequency histogram of white crappie collected by frame nets in New Wall Dam, 2002 & 2006.

Largemouth bass

During night electrofishing only largemouth bass were sought. Night electrofishing is done annually to evaluate the bass population and protected slot regulation imposed on the bass in New Wall Lake. Extreme low water conditions reduced the amount of shoreline that could be sampled with only 28.3 minutes of electrofishing total. A total of 16 largemouth bass were captured (Table 6). Mean CPUE was 34.8 for all largemouth bass. CPUE for largemouth bass stock length and longer was 13.2. These values are down from last year's CPUE's of 45.9 and 43.7, respectively (Table 8). Only six fish over stock length (200mm) were sampled. Sample size was so small that stock indices and fish conditions are hard to compare to years past.

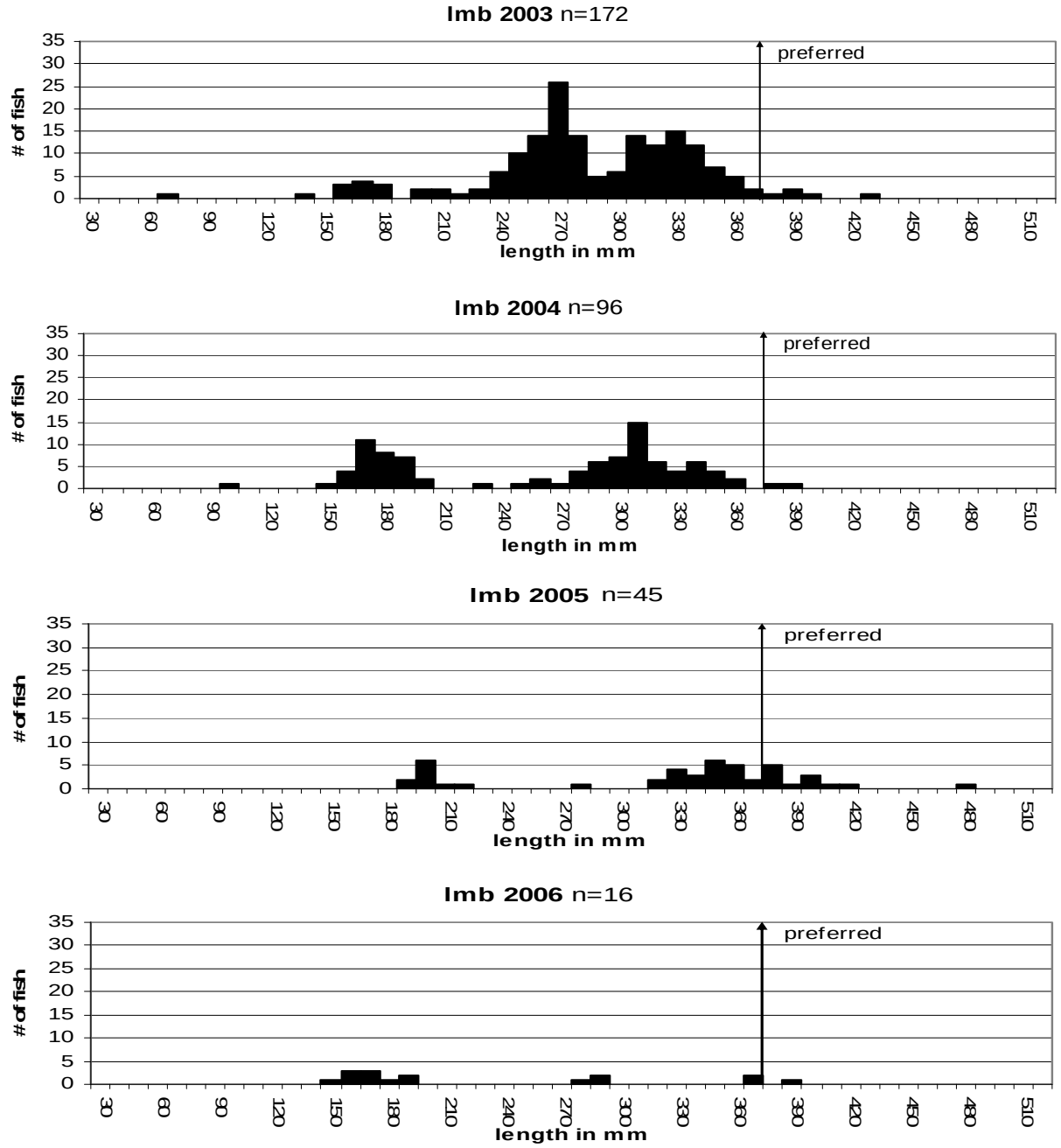


Figure 3. Length frequency histogram for Largemouth Bass at New Wall Dam for 2002-2006 with arrow representing 15 inches.

Table 6. Total catch (N), pedal time (seconds), catch per hour of electrofishing (CPUE), mean total length (TL, standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% confidence intervals are given in parentheses) and condition factor (Wr for fish ≥ stock length; 80%CI's) for largemouth bass collected by electrofishing in New Wall Dam, 1999-2006.

Year	N	Pedal Time (sec)	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
1999	183	4,169	158.0 (na)	126.9 (na)	41 (7)	10 (4)	na
2000	105	5,612	67.4 (na)	59.0 (na)	50 (9)	7 (5)	125.5 (1.8)
2001	206	6,960	106 (20.2)	57.7 (12.4)	76 (7)	8 (4)	100.9 (0.1)
2002	204	3,950	184.8 (34.8)	91.4 (16.5)	37 (8)	1 (2)	97.8 (1.1)
2003	172	3,600	172.0 (25.6)	160.0 (24.4)	49 (7)	3 (2)	99.6 (0.4)
2004	96	3,146	108.5 (20.9)	72.8 (10.7)	73 (9)	5 (4)	108.5 (0.2)
2005	45	3,484	45.9 (15.8)	43.7 (15.3)	79 (11)	28(12)	103.0 (1.4)
2006	16	1,700	34.8 (22.0)	13.2 (8.6)	50 (45)	17 (33)	106.1 (5.1)

Yellow Perch

New Wall appears to have a poor quality perch population, which seems to be the case with most small dams with large population of bluegill and crappie. Gillnet CPUE was 43.5 in 2002, this survey it was 39.5. Size structure remains low with a PSD, for the 79 fish sample, was 8 with an RSD-P of 0. In 2002, the gill net sample PSD was 5 and RSD-P was 0. Wr for stock length and larger perch from the frame net was 83.8 (Table 1). Confidence intervals were much lower on the frame net Wr than the gill net data. In 2002, framenets captured 12 perch compared to 98 this survey. Size structure was better in the frame nets with a PSD of 25 and a RSD-P of 5. Most of these fish were covered in parasites, probably black grubs.

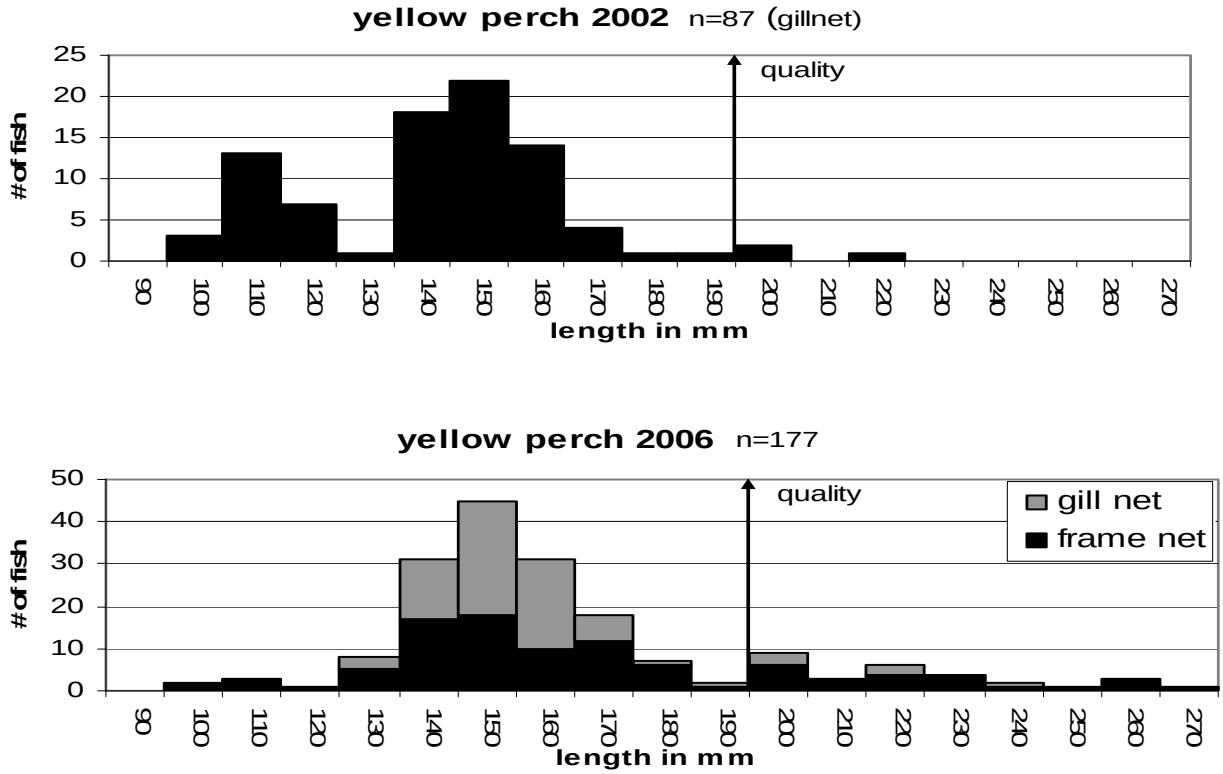


Figure 4. Length frequency histogram of yellow perch collected in New Wall Dam, 2002, 2006.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes

RECOMMENDATIONS

A. Continue to conduct lake surveys in New Wall Dam on an as needed basis. Conduct electrofishing surveys annually to assess the largemouth bass population.

APPENDICES

Appendix A. Stocking record for New Wall Lake, Pennington County, 1987-2006.

Year	Number	Species	Size
1992	4,300	Largemouth bass	Fingerling
1993	2,000	Largemouth bass	Fingerling
	4,600	Walleye	Fingerling
1994	4,300	Largemouth bass	Fingerling
1995	400	Walleye	Fingerling
1996	4,300	Largemouth bass	Fingerling
	1,200	Walleye	Fingerling
1997	4,300	Largemouth bass	Fingerling
1998	4,300	Largemouth bass	Fingerling
1999	3,000	Largemouth bass	Fingerling
2001	18	Black crappie	Adult
	50	Bluegill	Adult

Appendix B. New Wall Lake water chemistry profile taken on July 27, 2006.

Depth(ft)	Temperature	Dissolved O2	Conductivity
1.8	22.8	9.4	839.0
3.5	22.9	9.2	838.0
5.3	22.9	9.1	838.0
7.5	22.9	9.1	837.0
8.5	22.9	9.1	838.0
10.3	22.9	9.1	837.0
11.9	21.8	6.0	835.0
13.9	21.4	2.4	832.0

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Pactola Reservoir County: Pennington
Legal description: Sec. 2,3,4,5,10,11; R5E, T1N and Sec.31,32,33,34;R5E,T2N
Location from nearest town: 0.5 miles east of Silver City, S.D.
Dates of present survey: 26-28 July 2006
Date last surveyed: 3-4 August 2005
Most recent lake management plan: F21-R-26 Date: 1993
Management classification: Coldwater Permanent
Date contour mapped: 1985

Primary Species:
1. Hatchery rainbow trout
2. Lake trout
3. Brown trout

Secondary and other species:
1. White sucker
2. Green sunfish
3. Rock bass
4. Yellow perch
5. Largemouth bass
6. Rainbow smelt
7. Bluegill
8. Black crappie
9. Northern pike

PHYSICAL CHARACTERISTICS

Surface Area: 785.3 acres; Watershed: 204,154 acres
Maximum depth: 165.8 feet; Mean depth: 62.3 feet
Lake elevation at survey (from known benchmark): 75 % full

1. Describe ownership of lake and adjacent lakeshore property:

The Bureau of Reclamation (BOR), an agency of the U.S. Department of Interior, operates Pactola Dam and Reservoir in accordance with the needs dictated by downstream water demands such as irrigation, domestic water supply, regulation of Pactola Reservoir levels, and maintenance of minimum flows in Rapid Creek below the reservoir. The U.S. Forest Service (USFS) has jurisdiction over campgrounds, picnic areas, boat launches, access areas, and shoreline use. Private enterprises lease control of camping, marinas, and concession operations at various sites around the reservoir. A USFS visitor center, three parking lots, and some overlook areas are located on the dam. Veteran's Point, a handicap parking lot with fishing access piers, is located at the north end of the dam.

2. Describe watershed condition and percentages of land use:

The majority of the watershed is public timber and grassland administered by the USFS. However, significant areas of private ownership exist. Much of the land immediately adjacent to

the Rapid Creek watershed streams is privately owned with a small portion under tillage. Livestock grazing is widespread on both private and public lands. Much of the public land is under management for production of salable timber products. Extensive thinning of ponderosa pine on public land has taken place or is under way to enhance water yield. Roads and livestock grazing are major sources of sediment in the streams. Mountain slopes vary from moderate to extreme steepness on the lake shore as well as on the watershed. Localized disturbance contributes to increased siltation.

Deerfield Reservoir is located on the upper portion of the Castle Creek watershed above Pactola Reservoir. Slate Creek Dam, Dumont Pond, and many small, unnamed stock ponds are also located within the Rapid Creek watershed above Pactola. In addition, Silver City, Rochford, and several small developments exist in the upper Rapid Creek watershed.

3. Describe aquatic vegetative condition:

Vegetative density is light and grows only at the Rapid Creek inlet and in the shallow ends of bays off the main body of the lake.

4. Describe pollution problems:

Sediment entering Pactola from Rapid Creek seems to be the only apparent pollution concern in the reservoir.

5. Describe condition of all structures such as the spillway, level regulators, boat ramps, etc.:

All structures appear to be in good condition. In 1985-1986 the crest of the dam was widened and raised 15 feet. The rock-cut spillway was widened 150 feet to increase safety and capacity in the event of a major flood. At this time the splash pool below the spillway was also revamped. A low water boat ramp was installed at the north marina in 2005-2006.

CHEMICAL DATA

Water chemistry was conducted at Pactola on 23 August 2006 at site A near the dam (Figure 1). A thermocline was present near 45 feet, but oxygen levels remained high below this (Table 1).

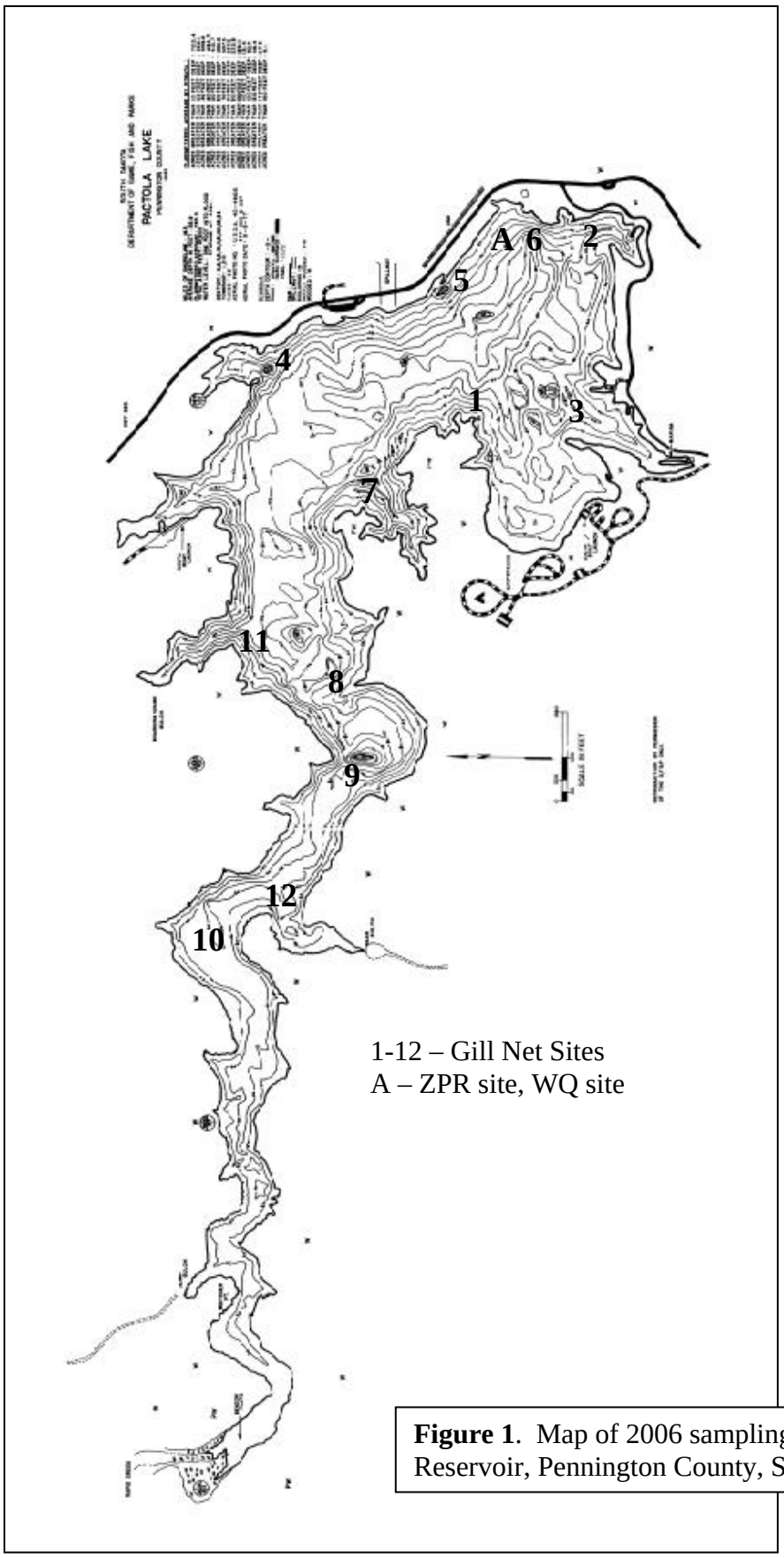


Figure 1. Map of 2006 sampling sites for Pactola Reservoir, Pennington County, South Dakota.

Table 1. Water quality data from site A on 23 August 2006 at Pactola Reservoir, Pennington County, South Dakota.

Depth	Temperature	DO Conc	pH
0.7	20.7	8.7	8.8
4.7	20.7	8.7	8.8
8.0	20.7	8.6	8.8
10.5	20.7	8.6	8.8
22.3	20.7	8.6	8.8
24.8	20.7	8.6	8.8
30.1	20.7	8.6	8.8
32.4	20.7	8.5	8.8
38.9	20.6	8.5	8.8
40.6	20.1	8.4	8.8
42.6	18.0	8.5	8.8
44.5	16.9	8.5	8.7
46.6	15.6	8.5	8.7
48.6	14.1	8.7	8.7
50.6	12.9	8.7	8.7
52.5	12.2	8.7	8.6
54.2	11.9	8.7	8.6
55.1	11.7	8.6	8.6

BIOLOGICAL DATA

Gill netting was conducted on 26-28 July 2006. Sampling consisted of 12 gill net nights (Figure 1). All gill nets were monofilament, experimental nets. Each net was 45.7 m (150-ft.) long and 1.8 m (6-ft.) deep with six 7.6 m (25-ft.) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). All fish captured were measured (total length, mm) and weighed (g). All data was entered into WinFin 3.42 (Francis 1999).

Fish population parameters were computed using WinFin Analysis (Francis 2000) and Microsoft Excel. Parameters calculated were catch per unit effort (CPUE) and relative weight (Wr). Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms. Fish condition was expressed as mean Wr.

The ZPR was measured twice monthly in June through August and once in September (see The Zooplankton Ratio for Use in the Black Hills Put-Grow-and-Take Fisheries report, December 2004 for explanation of ZPR). Plankton was collected by vertically towing three different mesh size (750µ, 500µ, and 153µ) plankton nets through the water column. Each net has a hoop diameter of 50 cm and is 150 cm long with a PVC collection cup attached to the end. The tow depth varied from 10 to 50 feet deep.

RESULTS AND DISCUSSION

Eleven species of fish, and bluegill-green sunfish hybrids, were collected from Pactola in 2006 (Table 2). Four species, hatchery rainbow trout, bluegill, yellow perch, and lake trout, were the most abundant fish sampled making up a combined 67% of the total fish caught.

Table 2. Total catch of twelve 150-foot, experimental, sinking, monofilament gill nets set in Pactola Reservoir, Pennington County, South Dakota on 26-28 July 2006.

Species	N	%	CPUE	PSD	RSD-P	Wr
Bluegill	60	12.4	5.0	5	0	97
Bluegill x gr. sunfish	26	5.4	2.2	-	-	-
Brown trout	42	8.7	3.5	-	-	79
Green sunfish	3	0.6	0.3	0	0	96
Hatchery rainbow trout	157	32.6	13.1	-	-	70
Lake trout	56	11.6	4.7	-	-	77
Largemouth bass	1	0.3	0.1	100	0	115
Northern pike	4	0.8	0.3	100	0	100
Rainbow smelt	1	0.3	0.1	-	-	-
Rock bass	44	9.1	3.7	0	0	77
White sucker	32	6.6	2.7	100	100	91
Yellow perch	56	11.6	4.7	68	6	85
Totals	**482**	**100**				

Brown Trout

The number of brown trout caught in gill nets has gradually decreased from 97 in 2002, to 84 in 2003, 52 in 2004, 40 in 2005, and 42 in 2006 (Figure 2). Although some brown trout were stocked in 2000 and 2002 (approximately 11,000), naturally reproduced brown trout have been sampled from Pactola annually. Mean condition (Wr) of brown trout smaller than 14 inches in length has been rather poor during sampling, ranging from mid 70's to mid 80's (Table 2). Larger brown trout, however, generally show good condition. A possible reason is several brown trout stomachs were examined during sampling and found to contain rock bass and other fish remains. These fish are important components to reducing the number of "undesirable" fish in Pactola in addition to providing "trophy" fishing at Pactola. The length frequency graphs indicate fewer larger browns are in the lake, but the average size is about the same (Figure 2).

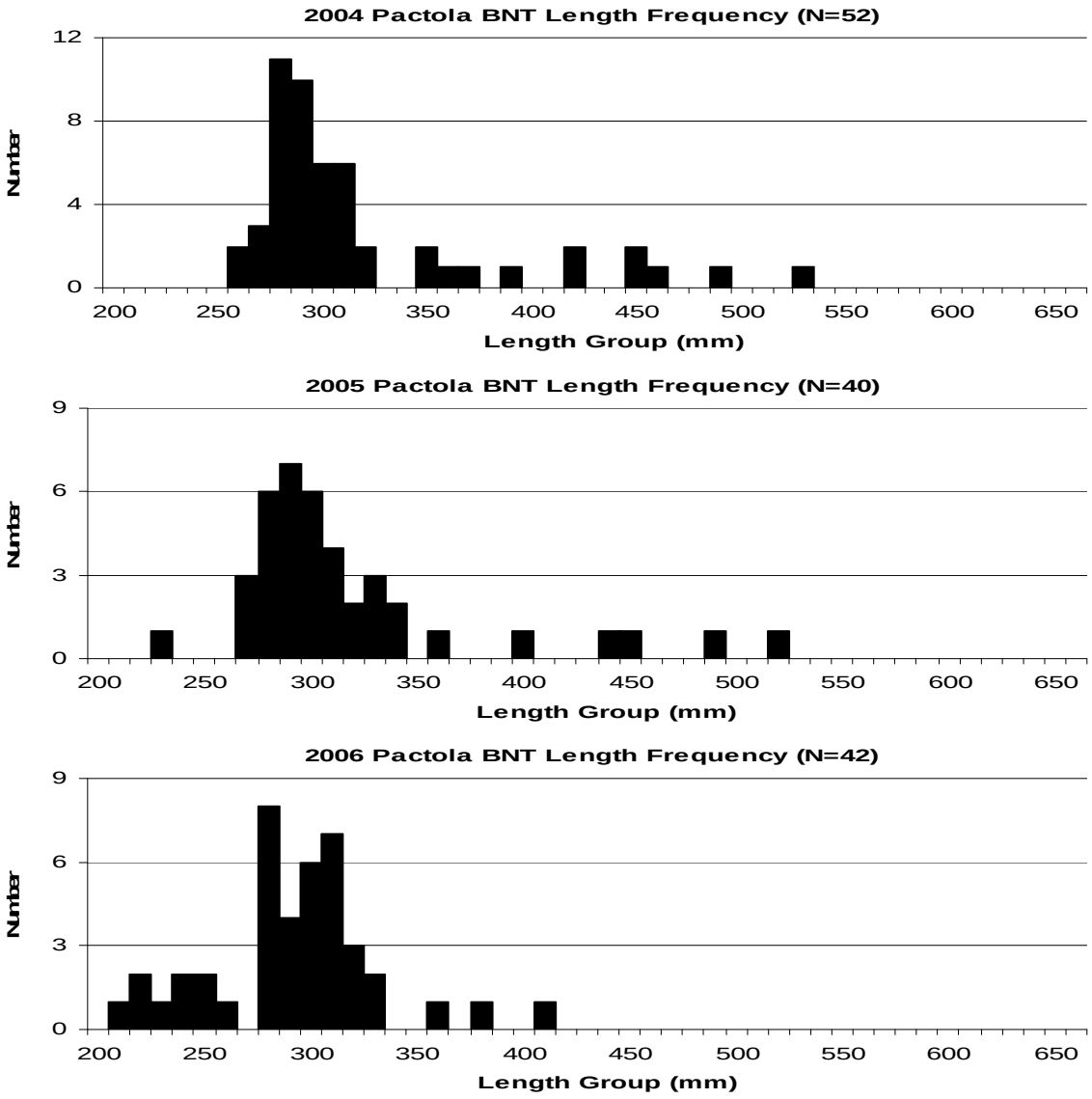


Figure 2. Length frequency histograms for brown trout sampled from Pactola Reservoir, Pennington County, South Dakota.

Table 2. Wr values for brown trout from Pactola Reservoir, Pennington County, South Dakota.

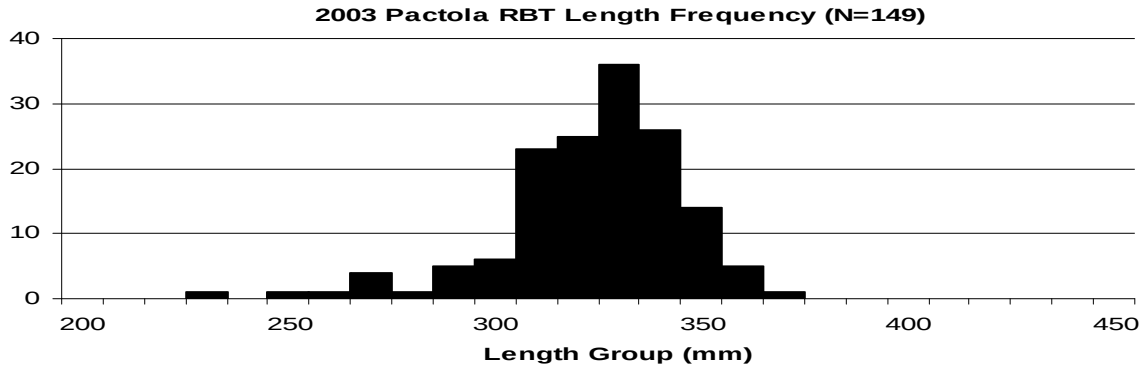
Year	Mean Wr	Wr < 350 mm	Wr > 350 mm
2002	86.3	84.8	96.9
2003	81.1	78.3	118.3
2004	81.2	75.7	99.4
2005	78.0	74.6	97.4
2006	79.0	78.5	85.5

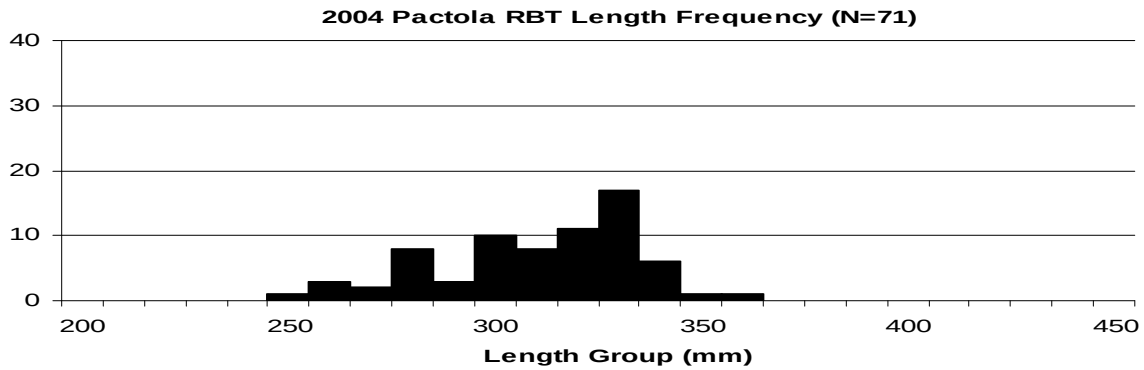
Hatchery Rainbow Trout

The number of hatchery rainbow trout declined from 149 in 2003 to only 71 in 2004, but were up to 140 in 2005 and even higher in 2006 with 157. Condition of hatchery rainbow trout has been low over the past four years. Mean condition has remained in the low 70's and reached it's lowest in 2006 (Table 3). Length frequency histograms show a majority of rainbow trout caught during sampling are over 12 inches with a few greater than 14 inches (Figure 3). Stockings of catchable rainbow trout are normally with 11 inch fish and some stockings in Spring 2006 were even smaller trout, indicating the trout are growing despite the apparent poor relative condition.

Table 3. Wr values for rainbow trout from Pactola Reservoir, Pennington County, South Dakota, 2006.

Year	Mean Wr	Wr < 350 mm	Wr > 350 mm
2003	74.1	74.8	69.6
2004	71.3	71.3	72.6
2005	73.0	73.1	72.2
2006	70.0	70.8	66.0





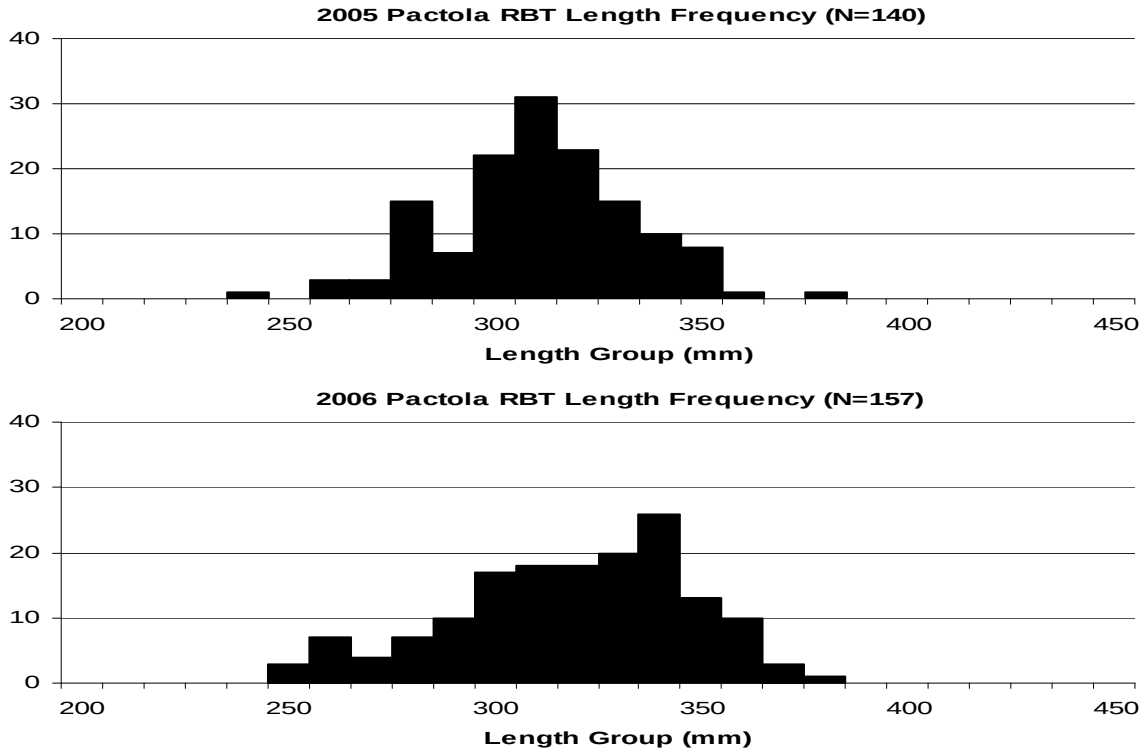


Figure 3. Length frequency histograms for rainbow trout sampled from Pactola Reservoir, Pennington County, South Dakota.

Lake Trout

Lake trout were stocked in spring 2003 and fall 2005. The 2003 stocking had shown little growth over the first 3 years of sampling, but have now exhibited 2-4 inches of growth as indicated by Figures 4 and 5. The mean length of this group of lake trout actually decreased from 303 mm in 2003 to 293 mm in 2004. Their mean length in 2005 was 313 mm. It increased this year to 374 mm. A larger size (14 inch mean) lake trout stocking took place in the fall of 2005. These fish were differentially marked to determine the success of stocking larger versus smaller lake trout. The average length of these is greater than the 2003 stocking after 3 years of growth. Several naturally reproduced lake trout were observed for the third straight year. The wild lake trout had the highest mean Wr values.

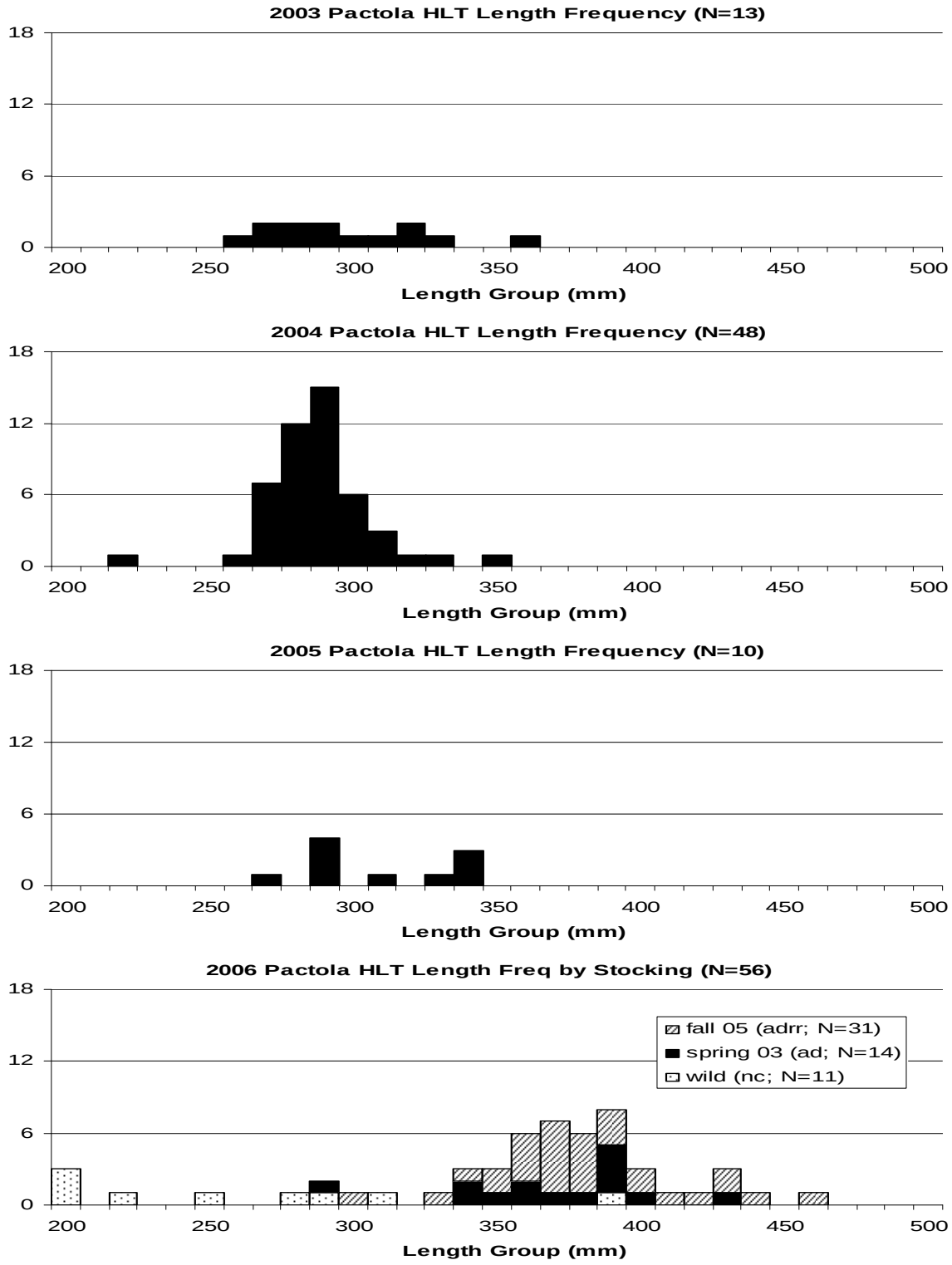


Figure 4. Length frequency histograms for lake trout sampled from Pactola Reservoir, Pennington County, South Dakota.

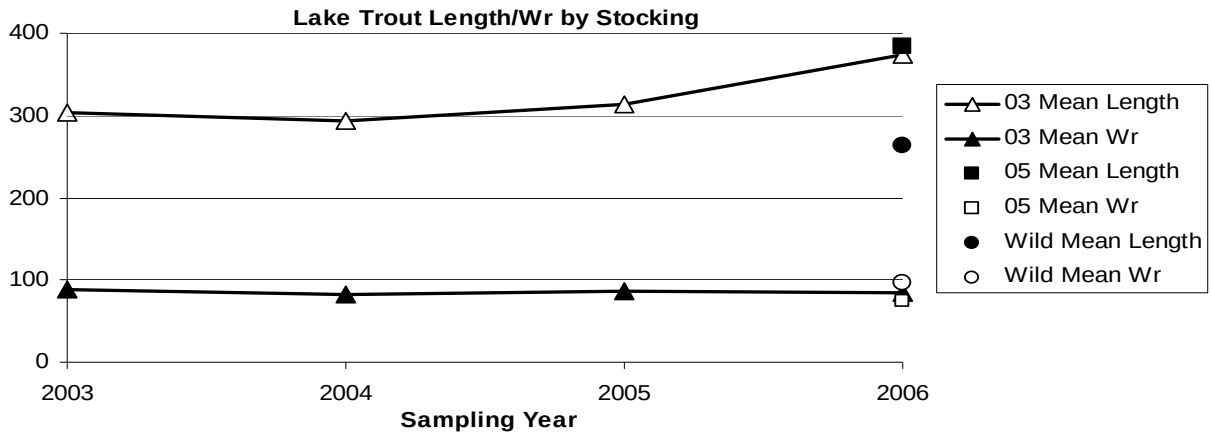


Figure 5. Lake trout mean length and Wr separated by the 2003 and 2005 stockings as well as wild fish in Pactola Reservoir, Pennington County, South Dakota.

Secondary Species

Bluegill and yellow perch continue to have a large presence in Pactola. There were anecdotal reports of anglers targeting these species during 2006. Rock bass were collected and are still being utilized as food by brown and lake trout. No European rudd were caught in 2006. Only 4 northern pike were sampled.

ZPR

The zooplankton ratio data for Pactola Reservoir is presented in Figure 6. The mean ZPR (750:153) at site A in 2004 was 0.11, 0.24 in 2005, and 0.19 in 2006. The mean zooplanktor length was 1.15 mm in 2004, 1.33 mm in 2005, and 1.11 in 2006. These values are near the objectives of 0.20 and 1.0 mm, respectively. However, trout condition did not change as anticipated. The volume of plankton available to trout may be the limiting factor to trout condition as well as the ratio.

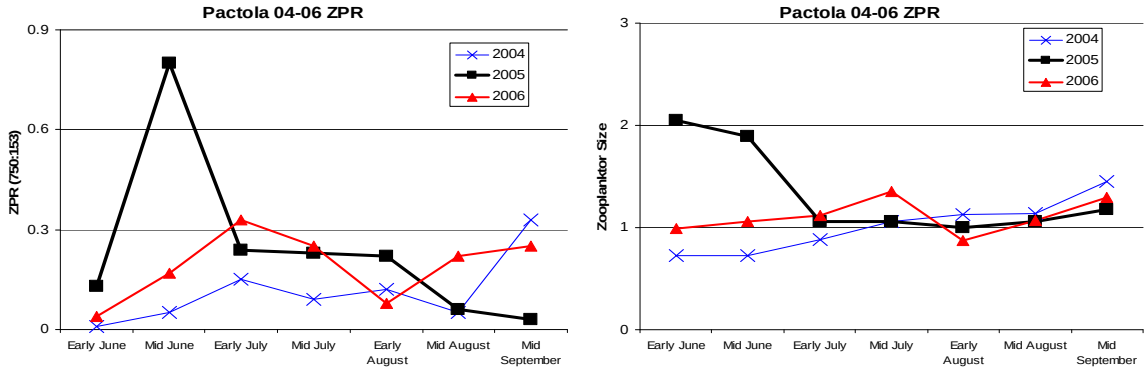


Figure 6. ZPR indices for Pactola Reservoir, Pennington County, South Dakota, 2004-2006.

RECOMMENDATIONS

1. Conduct a lake survey in 2007.

2. Do not increase rainbow trout stocking numbers. The rainbow condition should improve before stocking numbers are increased.

3. Develop a brown trout plan to maintain this “trophy” opportunity in Pactola as this is an important component to the overall Pactola fishing experience. The numbers of larger browns is currently decreasing.

4. Continue to analyze the lake trout stocking program with the results from the lake surveys. These fish spend much longer times in the hatchery compared with rainbow trout and should be evaluated to maximize stocking efficiency associated with cost and benefit.

REFERECNES

Francis, J. 1999. WinFin, Version 3.42; Microsoft Access Program for data entry. Nebraska Game and Fish Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.7. Nebraska Game and Fish Commission, Lincoln.

APPENDICES

Appendix 1. Stocking record for Pactola Reservoir, South Dakota 1990-2006.

Species	Year	Number	Size
Brown trout	2000	2,911	catchable
	2002	7,922	catchable
Cutthroat trout	1990	31,589	fingerling
	1991	18,694	large fingerling
	1992	20,414	large fingerling
Emerald shiner	1991	1,000	adult
	1992	600	adult
Lake Trout	2003	9,955	catchable
	2005	7,451	catchable
Rainbow smelt	1992	150	adult
Rainbow trout	1990	109,143	fingerling
		4,000	catchable
	1991	35,000	large fingerling
		170,000	small fingerling
	1992	150	adult
		55,505	catchable
	1992	82,435	medium fingerling
		141,505	small fingerling
	1993	64,939	catchable
	1994	69,579	catchable
	1995	69,245	catchable
	1996	71,140	catchable
	1997	73,019	catchable
	1998	67,494	catchable
	1999	42,500	catchable
	2000	5,588	catchable
	2001	40,000	catchable
	2002	40,818	catchable
	2003	32,100	catchable
	2004	180	adult
		29,593	catchable
	2005	290	catchable
	2006	26,366	catchable
Splake trout	1991	27,550	fingerling
Spottail shiner	1991	1,000	adult
	1992	2,500	adult
	1993	2,000	adult

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Sheridan Lake County: Pennington

Legal description: Sec. 11,12,13,14; R5E; T1S and Sec. 7; R4E; T1S
Location from nearest town: 5 miles east and 2 miles north of Hill City, SD
Dates of present survey: 23-25 July 2006
Date last surveyed: 25-26 July and 14 October 2005
Most recent lake management plan: F21-R-38 Date: 1998
Management classification: Warmwater permanent
Contour mapped: June 1986

Primary Species: (game and forage)	Secondary and other species:
1. Rainbow trout	1. Northern pike
2. Yellow perch	2. Golden shiner
3. Black crappie	3. Green sunfish
4. Largemouth bass	4. White sucker
5. Brown trout	5. European rudd
	6. Black bullhead
	7. Rock bass

PHYSICAL CHARACTERISTICS

Surface Area: 383 acres Watershed: 95,311 acres
Maximum depth: 96 feet Mean depth: 30 feet
Lake elevation at survey (from known benchmark): 4,624 ft. (full)

1. Describe ownership of lake and adjacent lakeshore property:

Sheridan Lake was constructed by the Civilian Conservation Corps for recreational purposes in 1939. Sheridan Lake and its dam are maintained and operated by the U.S. Forest Service. The operation and maintenance of campgrounds, picnic areas, parking lots, and boat launch facilities are managed under a special use permit by non-government entities. These entities also cooperate with the U.S. Forest Service during major maintenance and improvement in the off season. The marina and concession operations are leased to private enterprise under other long-term use permits (Personal communication with Amy Ballard, USFS, 1995).

2. Describe watershed condition and percentages of land use:

The ownership of the Sheridan Lake watershed is 85.8% U.S. Forest Service (81,818 a or 31,111 ha) and 14.2% private (13,493 a or 5,461 ha) (Personal communication Jon Macy, USFS, 1994). The bulk of U.S. Forest Service land is managed for timber production, but is also grazed through a permit process. Most of this land is covered by pine or spruce forest interspersed with

meadows. Logging, thinning, and other timber management practices are ongoing. All of these activities contribute to the sediment load into Sheridan Lake carried by Spring and Horse creeks. Private land is less often forested and more often used as horse pasture, cattle grazing land, home sites, or campgrounds. The watershed also contains the town of Hill City and several other small developments. Small reservoirs including Mitchell, Major, Newton Fork, Thompson, Marshall Gulch, and several unnamed farm ponds are located within the watershed. Most of the watershed consists of hills with moderate to steep inclines. Roads and trails are prevalent throughout the watershed.

3. Describe aquatic vegetative condition:

Abundant emergent vegetation, primarily cattails, is present in the shallow ends of bays, along shallow shoreline areas, and near the inlets of Spring and Horse creeks. Submergent vegetation is abundant throughout the lake at depths of 6 to 8 feet. Algae blooms sometimes occur during the summer months and filamentous algae is found at times along the shoreline.

4. Describe pollution problems:

Siltation occurs at all inlets, especially the Spring and Horse Creek inlets, and is heavy due to agricultural use (grazing), timber/logging operations, highway runoff, and natural erosion. Moderate to heavy nutrient loads are entering the system.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

A faulty valve in the dam prevented controllable water releases from Sheridan Lake into Spring Creek during 2003. This valve was repaired in late 2004, but is not operational at this time.

CHEMICAL DATA

Sheridan was sampled for water quality on 23 August 2006 at site A (Figure 1). Field measurements included depth, temperature, dissolved oxygen, and pH (Table 1). Data was collected with an YSI model 6820 Multi-Parameter Water Quality Monitor and model 650 MDS data collector. A thermocline was present near 32 feet deep. Insufficient oxygen for trout began near 34 feet, but oxygenated, cold water was present at 28 – 32 feet deep.

Table 1. Water quality data collected on 23 Aug 2006 at site A in Sheridan Reservoir, Pennington County, South Dakota.

Depth (ft.)	Temperature (^{o}C)	DO Conc (ppm)	pH
2.0	21.8	9.2	8.9
4.2	21.8	9.2	8.9
5.8	21.7	9.2	8.9
7.9	21.7	9.1	8.9
10.5	21.6	9.1	8.9
12.0	21.6	9.1	8.9
14.8	21.6	9.0	8.9
15.9	21.5	9.0	8.9
18.2	21.5	9.0	8.9
19.9	21.5	9.0	8.9
22.6	21.5	9.0	8.9
24.1	21.3	9.0	8.9
25.8	19.3	9.3	8.9
28.3	15.6	8.4	8.8
30.8	13.7	5.2	8.7
32.0	13.2	4.4	8.6
34.2	11.8	3.3	8.6
37.4	10.7	2.3	8.5
38.9	10.2	2.0	8.5
40.3	9.8	1.8	8.5
43.1	9.2	1.4	8.4
44.8	9.0	1.3	8.4
46.3	8.8	1.2	8.4
50.1	8.6	1.0	8.4
53.0	8.4	0.9	8.3
56.7	8.3	0.8	8.3
60.0	8.2	0.7	8.3
62.8	8.1	0.7	8.3

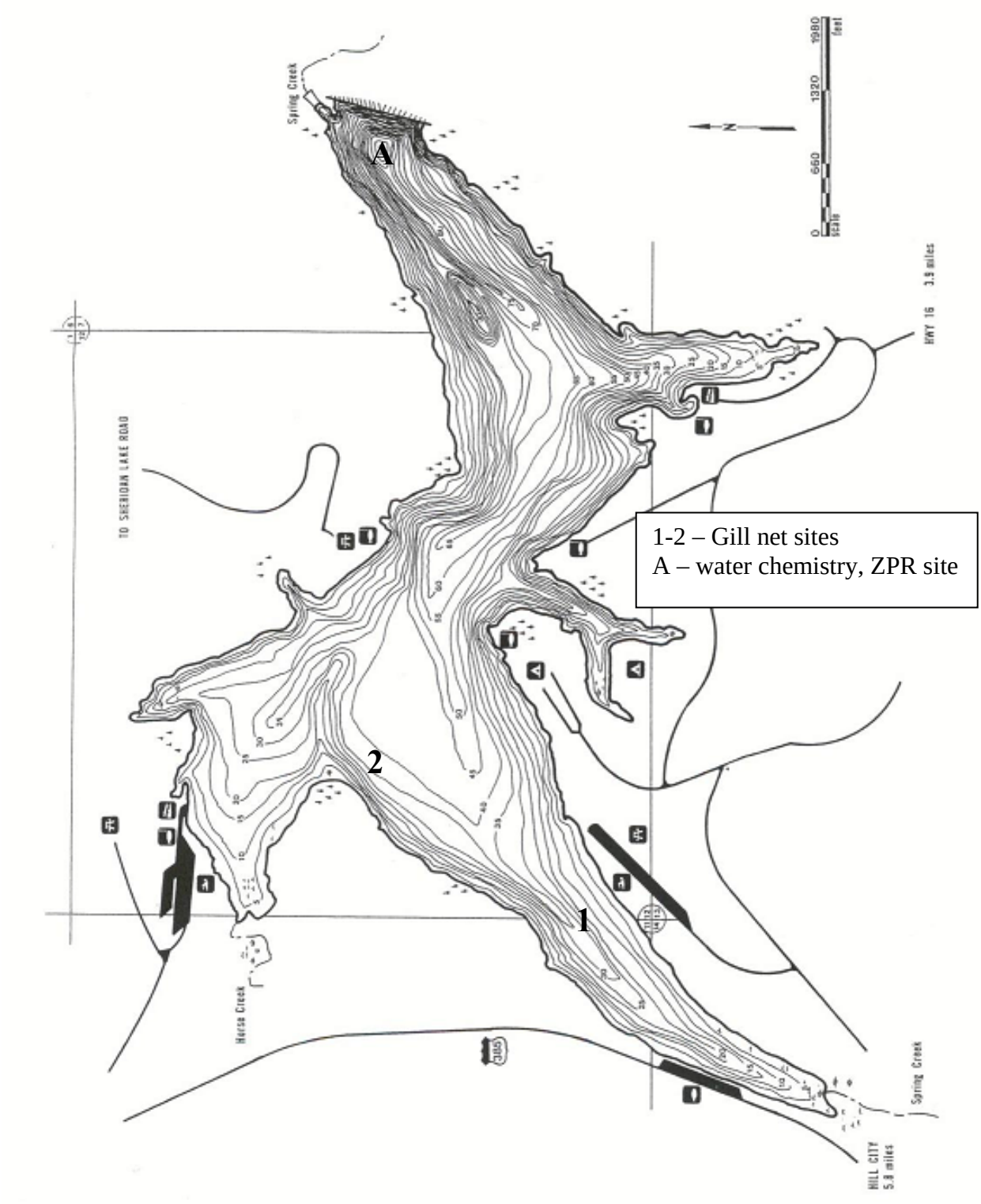


Figure 1. Lake map and sampling sites for Sheridan Lake, Pennington County, South Dakota.

BIOLOGICAL DATA

Two gill and 6 trap nets were used during sampling on 23-25 July 2006 (Figure 1). Both gill nets were monofilament, experimental nets. Each net was 45.7 m (150-ft.) long and 1.8 m (6-ft.) deep with six 7.6 m (25-ft.) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at 6 different stations, one net night each. All trap nets were modified fyke-nets with a 1.3 × 23 m (3.9 × 75.5-ft.) lead. All fish captured were measured (total length, mm) and weighed (g). Scales were collected from the first 5 fish of each centimeter group for yellow perch collected from gill nets. Night electrofishing was not conducted in 2006.

Fish population parameters, confidence intervals, and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD), and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr. Scale samples were collected according to Carlander (1977) for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector and the distance between scale annuli were recorded on paper strips. Data was entered into WinFin 3.42 (Francis 1999).

The ZPR was measured twice monthly in June, July, and August and once in September (see The Zooplankton Ratio for Use in the Black Hills Put-Grow-and-Take Fisheries report, December 2004 for explanation of ZPR).

RESULTS AND DISCUSSION

Eight fish species were caught in the gill nets totaling 229 fish (Table 2). Yellow perch were the most numerous species sampled. Seven species were sampled in trap nets (Table 3). The most numerous species caught was rock bass.

Table 2. Total catch for two 150-ft. experimental, sinking, monofilament gill nets in Sheridan Lake, Pennington County, South Dakota on 24 July 2006. Total number, CPUE (80% CI), CPUE-Stock (80% CI), PSD, RSD-P (90% CI), and Wr-Stock (90% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Black Bullhead	11	5.5 (13.9)	5.5 (13.9)	100 (0)	9 (17)	102 (4)
Hatchery brown trout	2	1.0 (3.0)	na	--	--	--
Hatchery rainbow trout	4	2.0 (3.0)	na	--	--	--
Largemouth bass	1	0.5 (1.5)	0.5 (0.5)	0	0	107.5
Northern pike	3	1.5 (4.6)	1.5 (4.6)	67 (33)	33 (67)	91 (9)
Rock bass	6	3.0 (9.2)	3.0 (9.2)	50 (45)	0	89 (3)
White sucker	9	4.5 (4.6)	4.5 (4.6)	100 (0)	100 (0)	94 (2)
Yellow perch	193	96.5 (238)	71.0 (160)	78 (6)	1 (2)	99 (1)
Total	**229**					

Table 3. Total catch of 6 trap-net nights in Sheridan Lake, Pennington County, South Dakota on 24 June 2006. Total number, CPUE (80% CI), CPUE-Stock (80% CI), PSD, RSD-P (90% CI), and Wr-Stock (80% CI) are reported.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr≥S
Black bullhead	18	3.0 (0.8)	3.0 (0.8)	100 (0)	6 (12)	85 (4)
Black crappie	2	0.3 (0.5)	0.3 (0.8)	50 (0)	0	--
Green sunfish	10	1.6 (1.6)	1.6 (1.6)	30 (28)	0	--
Northern pike	1	0.1 (0.3)	0.1 (0.3)	0	0	--
Rock bass	118	19.6 (11.1)	19.6 (11.6)	25 (7)	1 (1)	--
Rudd	42	7.0 (8.2)	--	--	--	--
Yellow perch	55	9.1 (9.2)	9.1 (9.2)	45 (12)	0	--
Total	**246**					

Largemouth bass

Electrofishing for bass was not conducted in 2006, thus results from the 2005 survey are repeated in this report. The PSD (12 inches) of largemouth bass sampled during night electrofishing is within the panfish option range according to Willis et al. 1993 (Figure 2). The RSD-P (15 inches) was also at an acceptable level for the panfish management option. The Wr remained high at 99 in 2005. The CPUE-S has been dropping over the past couple of years. Largemouth bass growth in 2005 was similar to the past 2 years, but still about 2 inches per year slower than the SD mean (Figure 4). Bass are reaching stock length (8 inches) at about 3 years of age. The length frequency histograms indicate that most bass are between 6 and 8 inches long (Figure 3). There were no bass longer than 15 inches sampled.

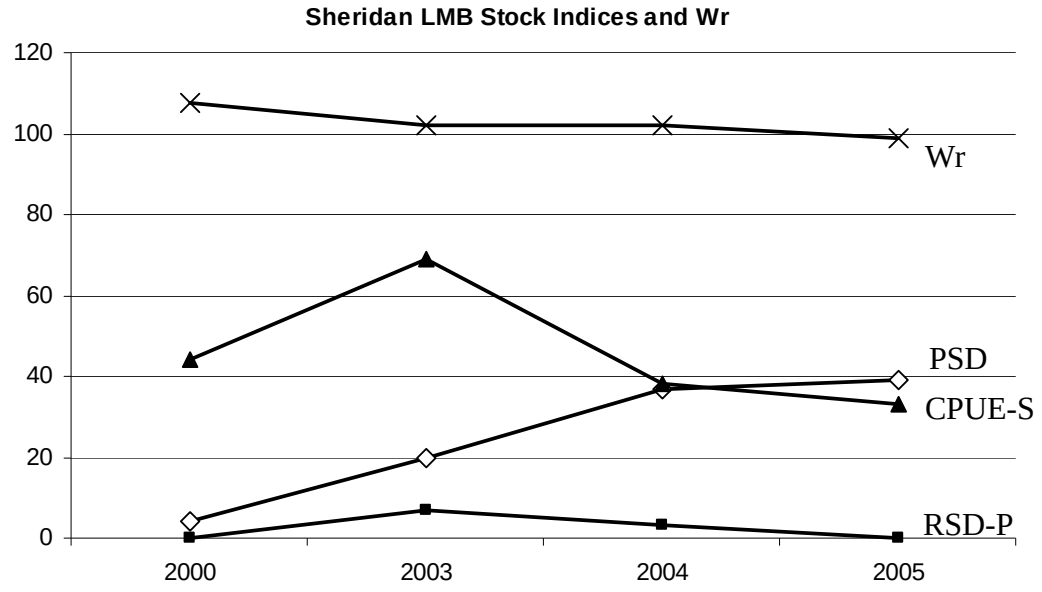


Figure 2. Stock indices and Wr's for largemouth bass sampled during night electrofishing on Sheridan Lake, Pennington County, South Dakota.

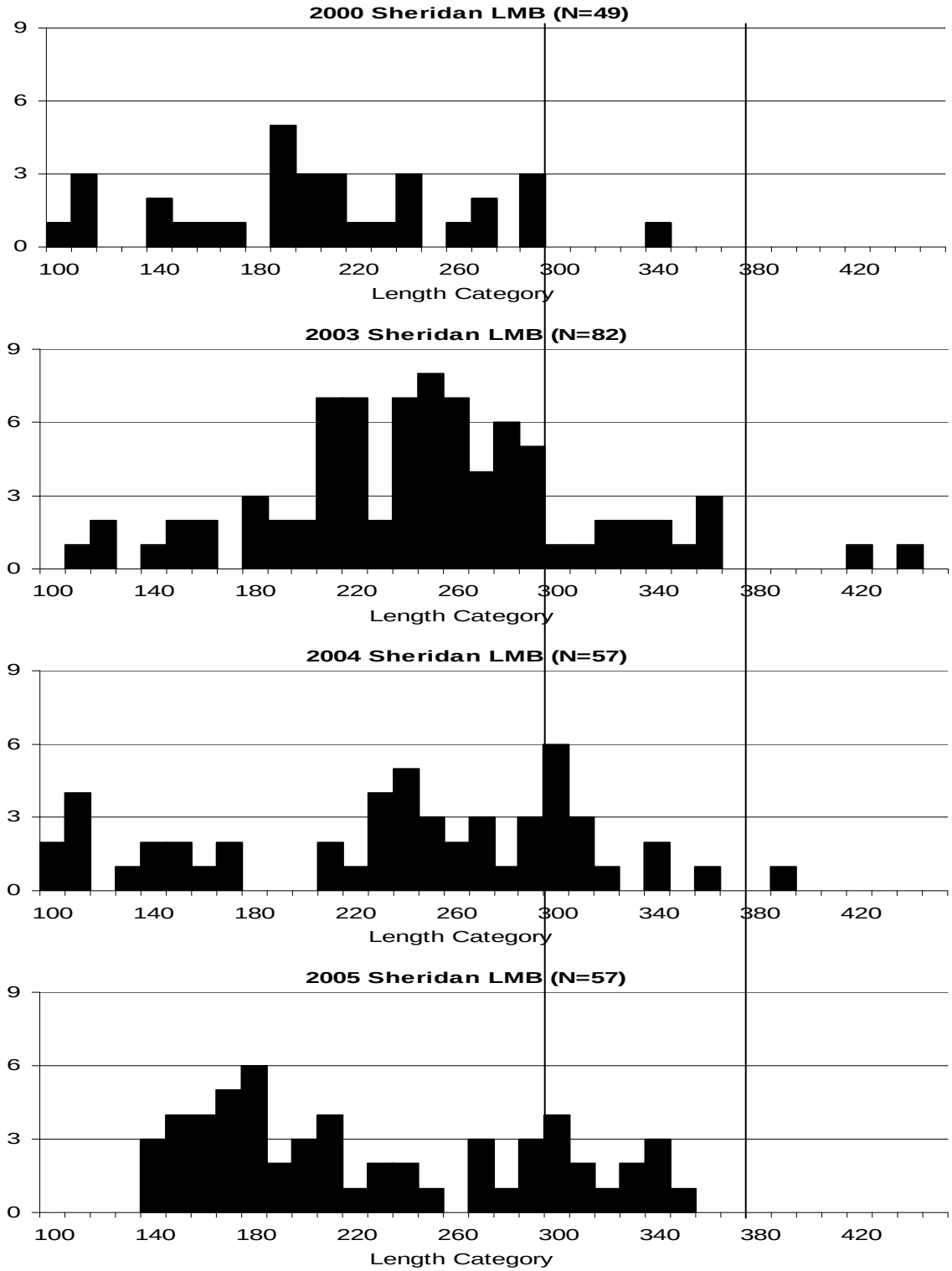


Figure 3. Length frequency histograms for largemouth bass collected by night electrofishing from Sheridan Lake, Pennington County, South Dakota. The solid vertical lines represent 12 and 15 inches.

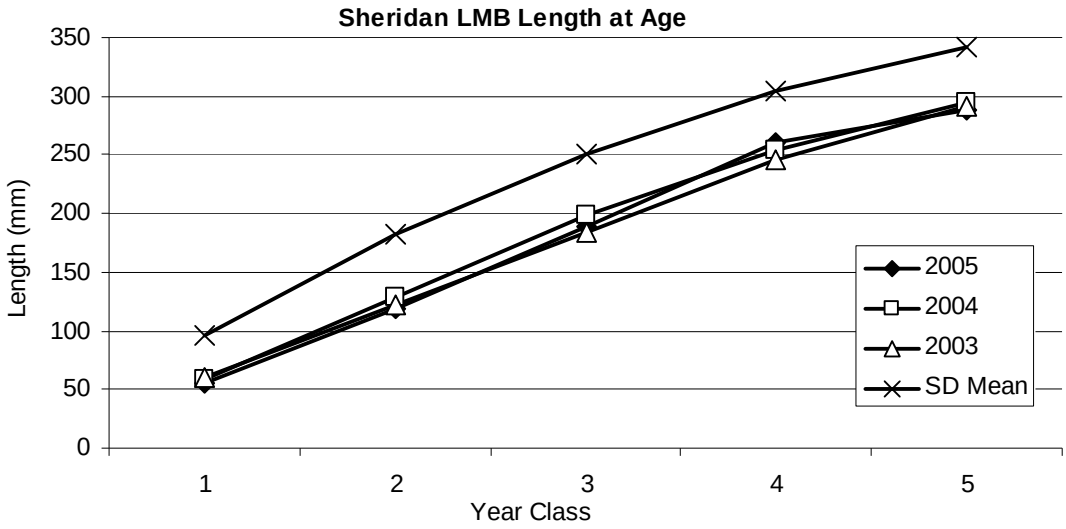


Figure 4. Mean length at age for largemouth bass from Sheridan Lake, Pennington County, South Dakota.

Yellow Perch

Sheridan Lake is partly managed for yellow perch. The PSD for Sheridan yellow perch is good at 78, however, the RSD-P dropped to 1 (Figure 5). The CPUE decreased quite a bit in 2005, but increased greatly this year. The Wr has continued to remain high. Yellow perch growth was similar to the past two years (Figure 6). Perch are reaching quality length at about 4 years old and are still slower than SD means.

The length frequency histograms indicate the majority of perch are still about 9 inches in length (Figure 7). It seems that yellow perch in Sheridan do not regularly exceed 10 inches in length. Otolith aging in 2005 indicated that one of these fish was 14 years old, but only grew to about 10 inches in length. Since perch are capable of surviving for many years, but do not continue to grow longer with age, it is likely that high energy food is unavailable for the perch to grow past lengths of about 10 to 11 inches. Unless a different, high energy food source becomes available, yellow perch in Sheridan may not reach sizes greater than currently observed. High fishing pressure and harvest may also be contributing to the perch population being "cropped off" when they reach a certain size. Perch just simply may not have a chance to grow because they are harvested at high rates.

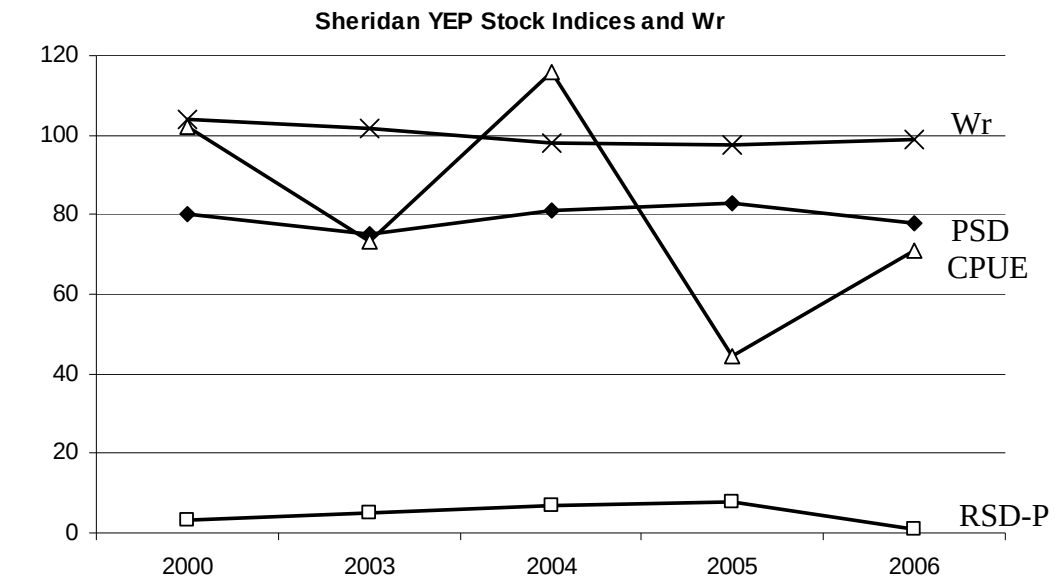


Figure 5. Stock indices and Wr's for yellow perch sampled in gill nets from Sheridan Lake, Pennington County, South Dakota.

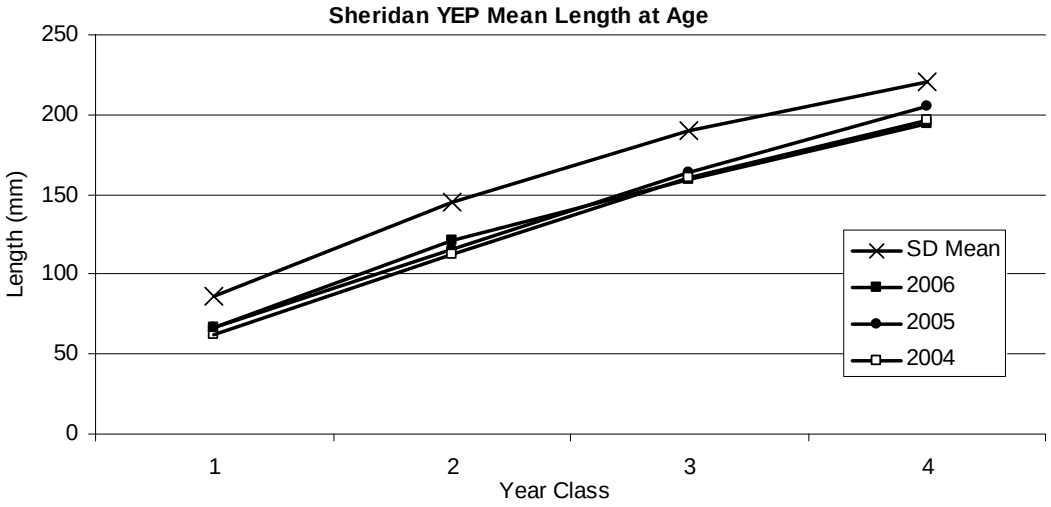


Figure 6. Mean length at age for yellow perch sampled from Sheridan Lake, Pennington County, South Dakota.

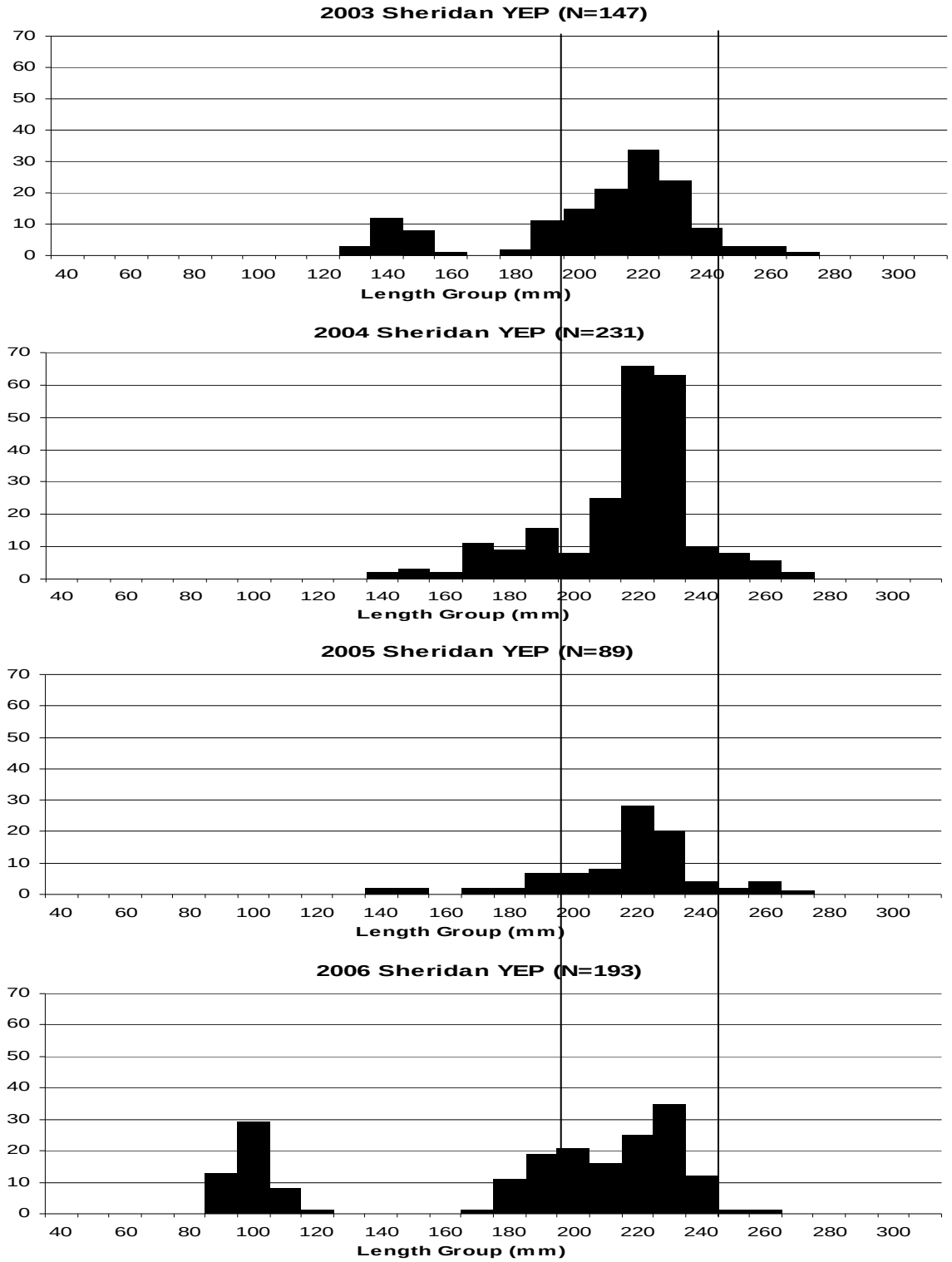


Figure 7. Length frequency histograms for yellow perch collected from gill nets at Sheridan Lake, Pennington County, South Dakota. The solid vertical lines represent 8 and 10 inches.

Rainbow Trout

Only 4 hatchery rainbows were sampled in 2006. The length frequency histogram shows that the rainbow trout size structure was similar to that in 2005, but with fewer fish (Figure 8). This indicates good growth for stocked rainbow trout since they were stocked at about 250 mm.

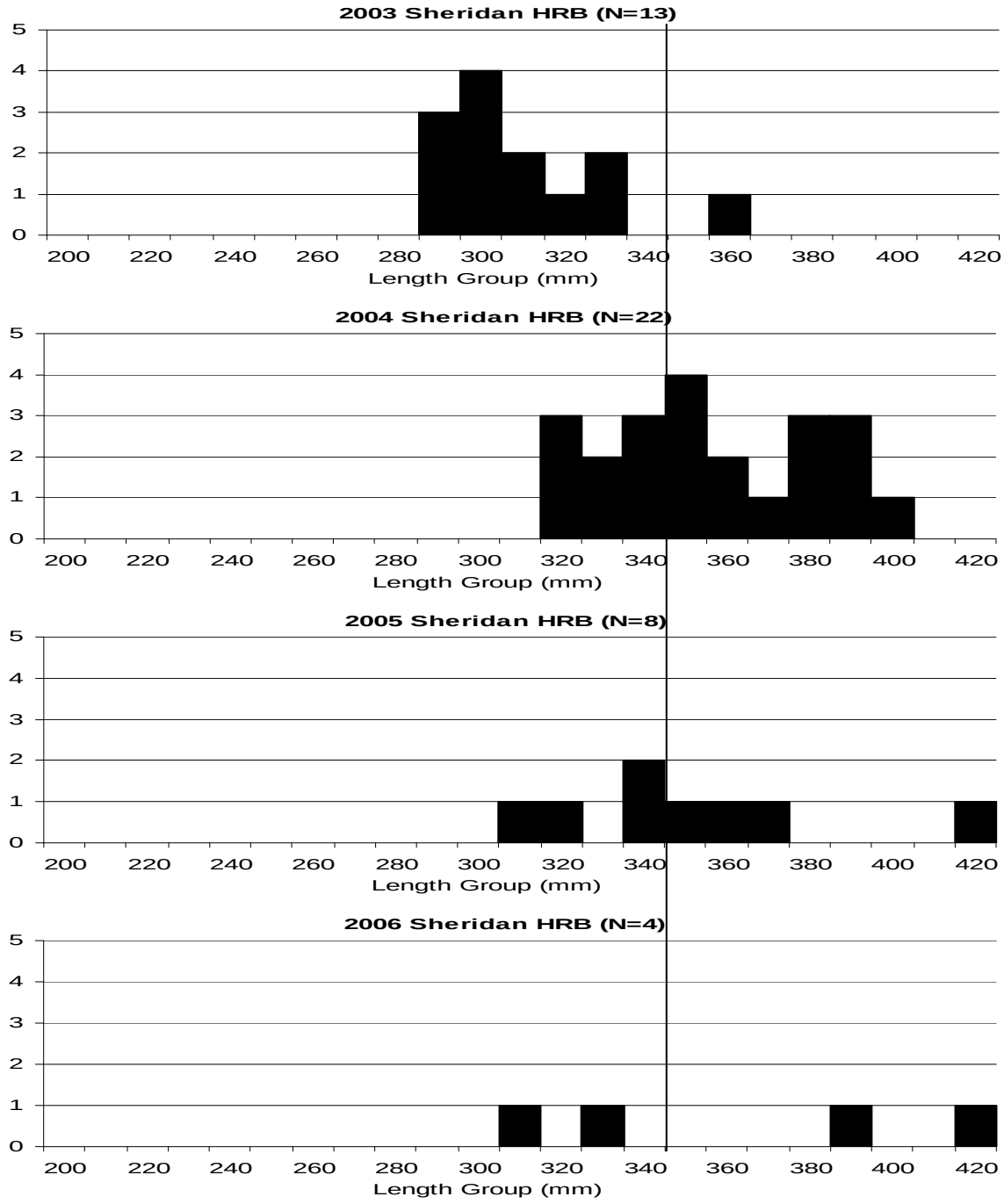


Figure 8. Length frequency histograms for hatchery rainbow trout collected from gill nets at Sheridan Lake, Pennington County, South Dakota. The solid vertical line represents 14 inches.

Other Species

Eight other species were sampled this year. Only 9 suckers and 11 bullheads were caught in gill nets. Three pike were sampled in the gill nets. The trap nets caught 118 rock bass. Brown trout were stocked in the spring of 2005. Two of these were sampled in gill nets and were in good condition.

ZPR

The zooplankton ratio data for Sheridan Reservoir is presented in Figure 9. The mean ZPR (750:153) was 0.52, up from 0.26 in 2005 and 0.31 in 2004. The mean zooplanktor size was 1.37, up from 1.07 mm in 2005 and 1.0 mm in 2004. The ZPR was an experimental sampling to attempt to relate zooplankton abundance and size structure to rainbow trout growth and condition. However, the results of the sampling have been unclear. Although ZPR numbers reached objectives, rainbow condition was actually lower than last year.

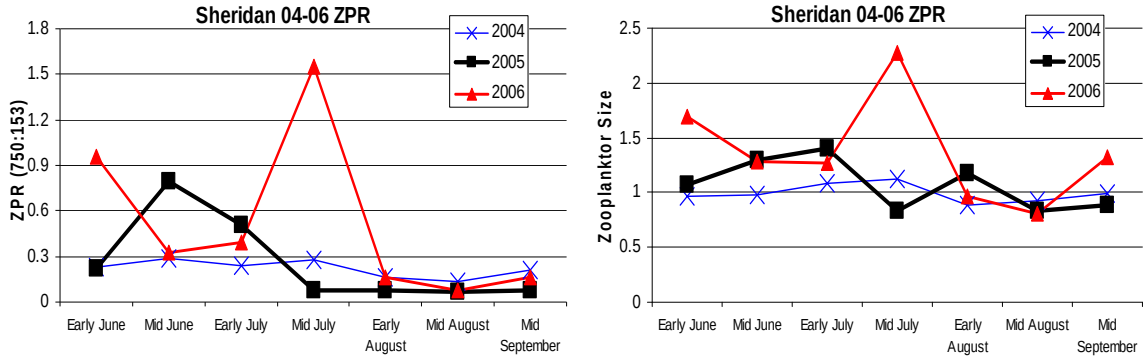


Figure 9. ZPR and zooplanktor size at Sheridan Lake, Pennington County, South Dakota.

RECOMMENDATIONS

1. Stock rainbow trout similar to last year.

2. Conduct annual lake survey in 2007.
    a. Gill and trap net sampling should be completed during late summer.
    b. Conduct night electrofishing during the fall for largemouth bass.

3. Stock brown trout in 2007.

4. Discontinue ZPR sampling.

LITERATURE CITED

Carlander, K.D. 1977. Handbook of Freshwater Fishery Biology, Volume 2. Iowa State University Press, Ames, Iowa.

Francis, J. 1999. WinFin, Version 3.42; Microsoft Access Program for data entry. Nebraska Game and Fish Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.7. Nebraska Game and Fish Commission, Lincoln.

Willis, D. W., B. R. Murphy, and C. S. Guy. 1993. Stock density indices: development, use, and limitations. Reviews in Fisheries Science 1:203-222.

Appendix 1. Stocking record for Sheridan Lake, South Dakota, 1980-2006.

Species	Year	Number	Size
Rainbow trout	1980	130,000	Fingerling
Rainbow trout	1981	133,139	Fingerling
Rainbow trout	1982	145,550	Fingerling
Rainbow trout	1983	141,220	Fingerling
Rainbow trout	1984	134,245	Fingerling
Rainbow trout	1985	130,020	Fingerling
Rainbow trout	1986	170,390	Fingerling
Rainbow trout	1987	130,172	Fingerling
Rainbow trout	1988	209,911	Fingerling
Rainbow trout	1989	140,808	Fingerling
Rainbow trout	1990	163,190	Fingerling
Rainbow trout	1991	130,003	Large fingerling
Rainbow trout	1992	100,000	Large fingerling
Rainbow trout	1993	100,000	Large fingerling
Rainbow trout	1994	45,667	12.6/lb
	1994	48,735	15.7/lb
Rainbow trout (Growth)	1995	34,000	15.0/lb
Rainbow trout (Kamloop)	1995	65,000	15.0/lb
Rainbow trout (McConaughy)	1995	4,065	3.7/lb
Rainbow trout (Kamloop)	1995	309	7.14/lb
Rainbow trout (Kamloop)	1996	99,827	15.0/lb
Rainbow trout	2003	15,000	Catchable
Rainbow trout	2004	20,400	Catchable
		10	Adult
Rainbow trout	2005	590	Catchable
Brown trout	2005	2,664	Catchable
Rainbow trout	2006	15,789	Catchable

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: East Lemmon Lake (Lemmon State Lake) County: Perkins
Legal description: T 21 N, R 17 E Sec. 16, 21
Location from nearest town: 11 mi. S. 7 mi. E Lemmon, SD
Dates of present survey: June 12-13, 2006
Date last surveyed: July 9-11, 2003; September 23, 2003
Most recent lake management plan: F21-R-29 Date: 1996
Management classification: Warmwater semi-permanent
Contour mapped: Date 1994

Primary Species: (game and forage)	Secondary and other species:
1. Largemouth bass	1. Tiger Muskie
2. Yellow perch	2. White sucker
3.	3. Black bullhead
4.	4. Channel catfish
5.	5. Golden shiner

PHYSICAL CHARACTERISTICS

Surface Area: 165 acres; Watershed: 49,500 acres
Maximum depth: 16 feet; Mean depth: 8.5 feet
Lake elevation at survey (from known benchmark): -3 feet

1. Describe ownership of lake and adjacent lakeshore property:

East Lemmon Lake is owned and managed by the South Dakota Department of Game, Fish and Parks. The dam structure and a small portion of the lake are located on private land.

2. Describe watershed condition and percentages of land use:

Ninety percent of the East Lemmon Lake watershed is privately owned agricultural land, the remainder is part of the Grand River National Grassland. The privately owned land is predominantly pasture and row crops, while the National Grassland is exclusively grazing land.

3. Describe aquatic vegetative condition:

Cattails and bulrush comprise much of the shoreline and littoral areas. During mid to late summer large mats of submergent vegetation are present throughout the lake.

4. Describe pollution problems:

No pollution problems were identified by department personnel during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

The spillway at East Lemmon Lake developed a cavity during the spring of 1995. A temporary repair of the badly damaged structure occurred in the fall of 1997. In the fall of 2000, a full repair of the dam including intakes, tubes and spillway was completed. The cost of the project at completion was $147,198. A boat ramp to provide public access was planned for the 2002 fiscal year, but has yet to be completed.

CHEMICAL DATA

1. Describe general water quality characteristics.

No water chemistry was done during the 2006 lake survey.

2. Thermocline: No

3. Secchi disc reading: No

4. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted on East Lemmon Lake June 12-13, 2006. Sampling consisted of two gill net nights and 6 trap net nights (Appendix C). The gill nets were a monofilament experimental net 45.7-m (150-ft) long and 1.8-m (6-ft) deep with six 7.6-m (25-ft) panels of bar mesh sizes: 12.7-mm (0.5-in), 19.1-mm (0.75-in), 25.4-mm (1.0-in), 31.8-mm (1.25-in), 38.1-mm (1.5-in), and 50.8-mm (2.0-in). Trap nets were set at eight stations consisting of 4 trap net efforts each day. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (0.75-inch) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on length categories. Abundance was expressed as the mean catch per unit effort (CPUE; mean number per net night or mean number per hour of electrofishing). Actual pedal time (time the electrofishing unit produced current) was recorded from the digital display on the control box

and used to calculate electrofishing CPUE. Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr.

Results and Discussion

East Lemmon Lake has been suffering from either summer or winter fish kills. These kills have decimated entire year classes of perch and bass. Sampling has shown that some fish have survived these kills and remain in high enough numbers to repopulate the lake on their own. Hopefully, lake levels will come up this spring and reduce the chances of more fish kills. Dominate fish species are discussed individually below.

Fish Community Survey

Gill and Trap Net Catch

A total of seven species were collected in both gill nets and trap nets during the 2006 survey of East Lemmon Lake. Five of the species, totaling 70 fish, were collected in experimental gill nets (Table 2). White sucker (N=46) was the most common species collected and yellow perch (N=19) the second most common. Other species collected in gill nets were golden shiner (N=2) green sunfish (N=1) and the recently introduced tiger muskie (N=2).

Five species were collected in trap nets, totaling 252 fish. Similar to gill nets white sucker (N=190) were the most common fish sampled. Black bullhead (N=56) were the second most common (Table 1). Two yellow perch, three largemouth bass and one tiger muskie were also sampled in the frame nets.

Table 1. Total catch (N), catch per net night (CPUE), catch per net night of stock length fish (CPUE-S), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from six frame nets in East Lemmon Lake, Perkins County, June 12-13, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black bullhead	56	9.3 (5.6)	9.3 (5.6)	73 (10)	61 (11)	108.2 (2.1)
Largemouth bass	3	0.5 (0.7)	0.5 (0.7)	--	--	129.5 (19.5)
Tiger muskie	1	0.2 (0.2)	--	--	--	--
White sucker	190	31.7 (30.1)	--	--	--	--
Yellow perch	2	0.3 (0.3)	0.3 (0.3)	--	--	101.6 (--)
Totals	252					

Table 2. Total catch (N), catch per net night (CPUE), catch per net night of stock length fish (CPUE-S), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and condition factor (mean Wr for stock length and larger fish) for all fish species from two experimental gill nets in East Lemmon Lake, Perkins County, June 12-13, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Golden shiner	2	1.0 (3.1)	--	--	--	--
Green sunfish	1	0.5 (1.5)	0.5 (1.5)	--	--	137.6 (--)
Tiger muskie	2	1.0 (--)	--	--	--	--
White sucker	46	23.0 (15.4)	23.0 (15.4)	100 (--)	98 (4)	112.1 (2.0)
Yellow perch	19	9.5 (4.6)	9.5 (4.6)	37 (20)	5 (9)	113.6 (2.6)
Totals	70					

Black bullheads

Black bullheads were the second most abundant fish captured in the trap nets. Mean CPUE in frame nets was 9.3 (Table 1). In 2003, CPUE was 9.6 showing a stable population. Bullheads ranged in size from 150 mm to 370 mm (Figure 2). Stock density indices were high with a PSD of 97 and a RSD-P of 71 from the frame net sample. Mean condition for stock length and larger fish was 108.2 (Table 1). These numbers would indicate a low to moderate population with high size structure and poor recruitment in recent years. Possibly the largemouth bass population and low water levels are keeping recruitment in check.

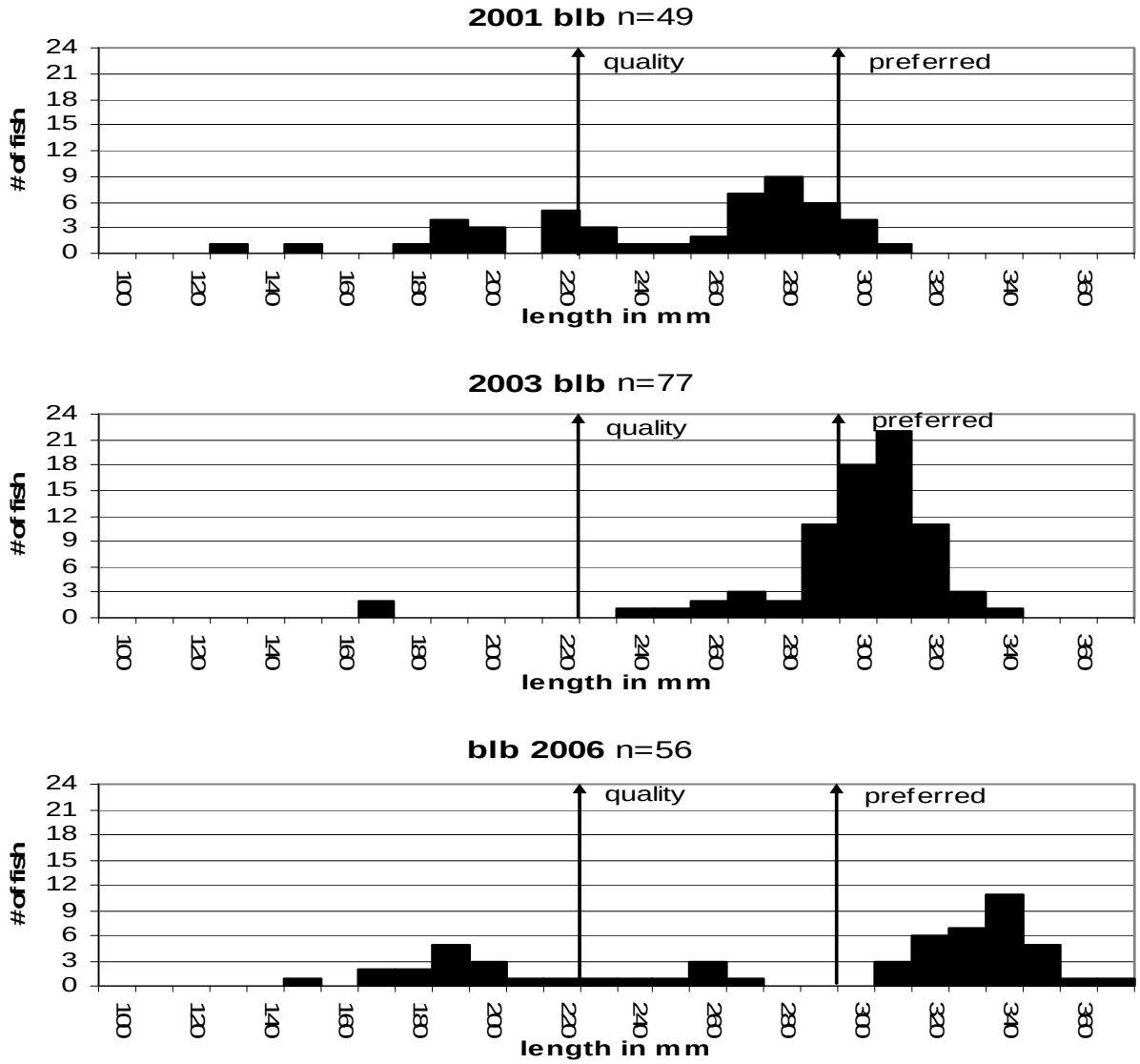
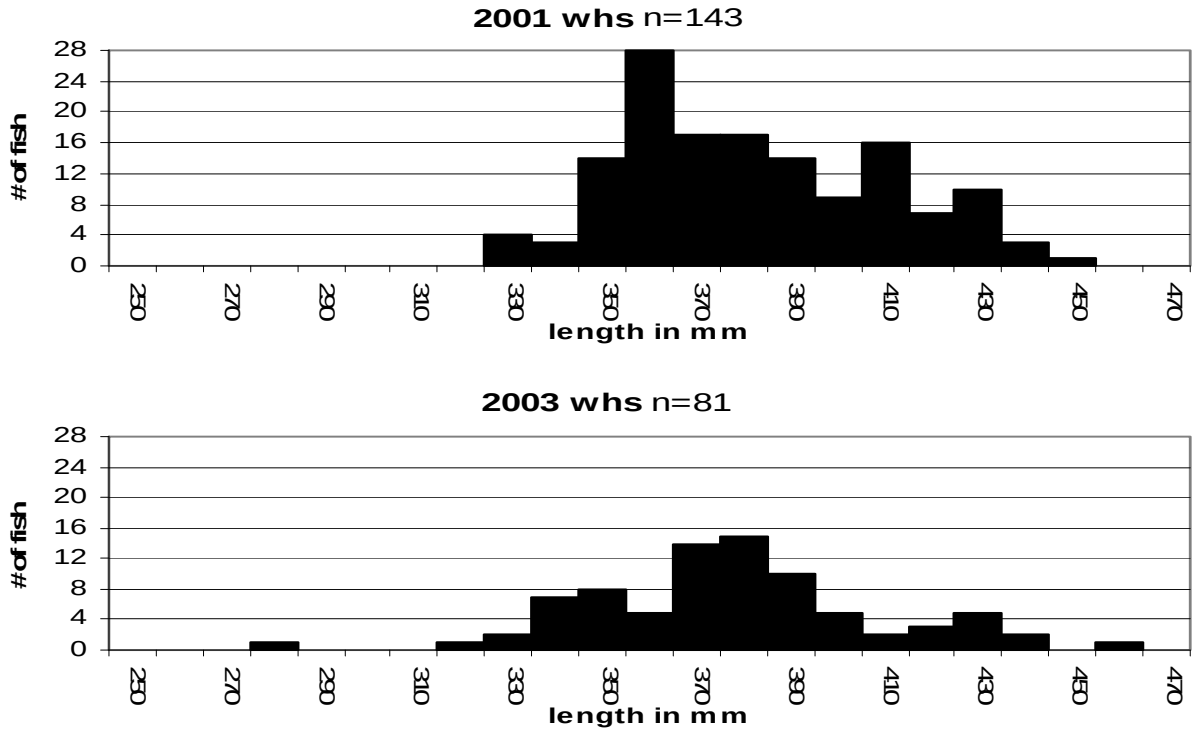


Figure 1. Length histogram of black bullheads collected in frame nets from East Lemmon Lake, Perkins County, 2001, 2003, 2006.

White suckers

A current management objective for East Lemmon Lake is to reduce the white sucker density. Sucker density has gone down, but white suckers were still the most numerous fish collected in both gill nets and trap nets. CPUE for gill nets was 23.0 and for trap nets 31.7 (Tables 1 and 2). In 2003, CPUE was 40.5 and 37.5, respectively. Size structure was high with RSD-P values of 98 or greater. Lengths of white suckers ranged from 290mm to 460mm (Figure 3). Mean Wr for stock length and larger fish was 112.1 (Table 2).

The white sucker population is extremely abundant, and is an ongoing problem in East Lemmon Lake. Low water levels with extensive submerged vegetation and high potential for summer and winter kills has added to the difficulty of establishing a good density of predators which is needed to control the white sucker population. The lake was rotenoned in 1981 to remove an overabundant sucker population. The watershed was not treated, however, and it was reported that the potential for re-overpopulation by suckers was high. It appears this population is doing well but hopefully a recovering largemouth bass population and the new tiger musky introduction can reduce the density.



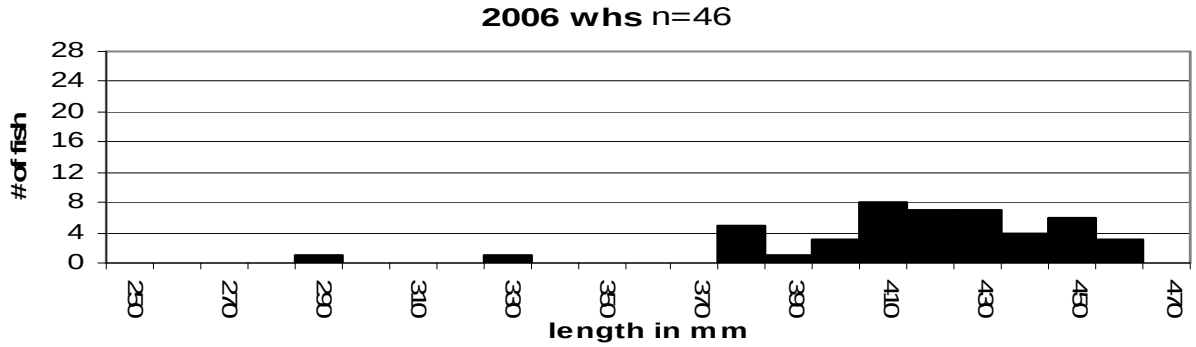


Figure 3. Length histogram of white sucker collected by gillnets from East Lemmon Lake, Perkins County, 2001, 2003, 2006.

Yellow perch

The current management objective is to increase and maintain yellow perch gill-net CPUE to 25 or greater for stock-length and larger fish and maintain PSD between 20 and 40.
Abundance of yellow perch was high in 2001, with a mean CPUE in trap nets of 38.3 and 205.0 in gill nets. The perch population crashed as CPUE was 0.3 and 1.5, respectively in 2003. This year CPUE was 0.3 for trap nets and 9.5 for gill nets with a PSD of 37 and a RSD-P of 5. While the stock indices are reaching the current management objective, CPUE is not.

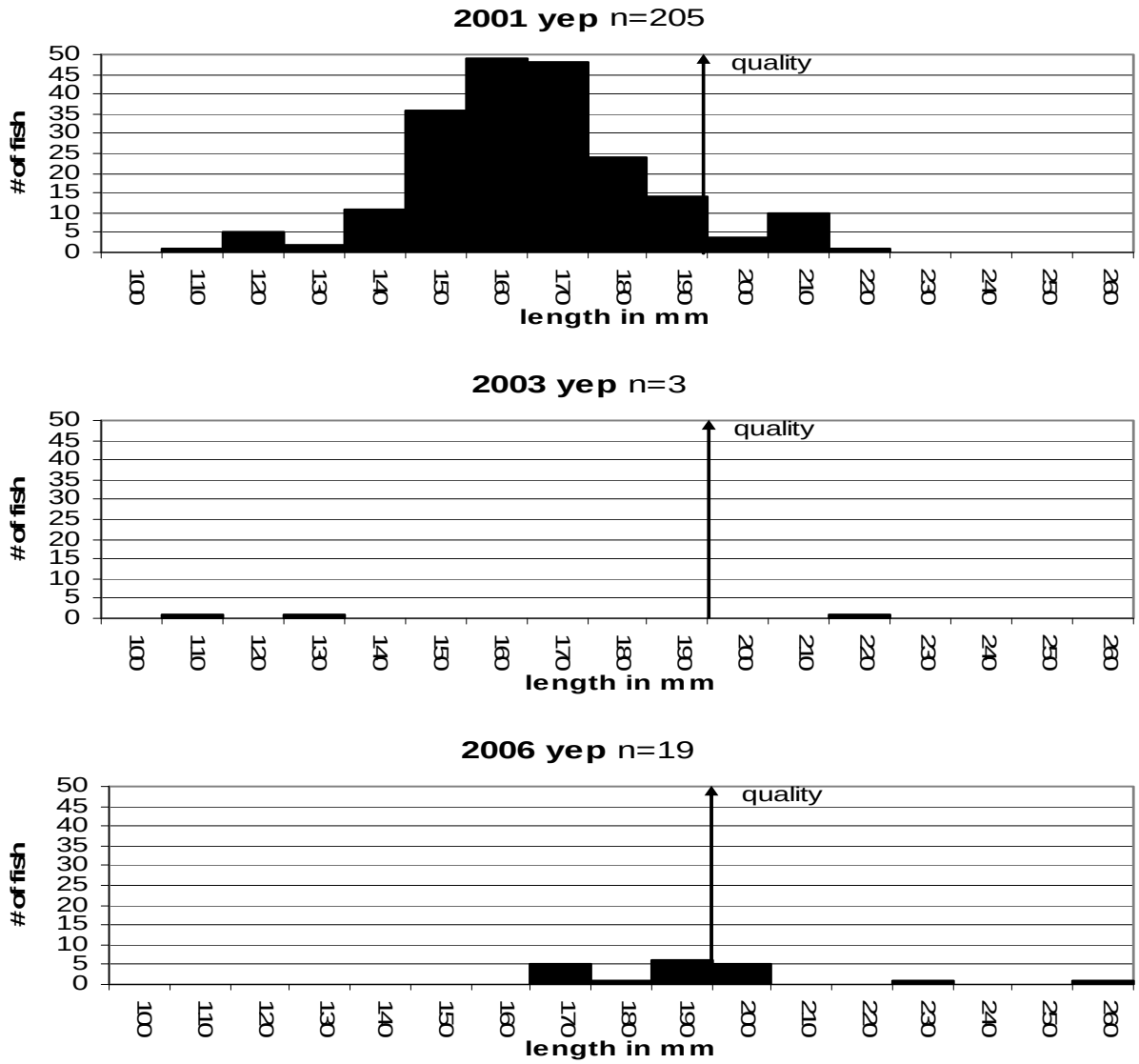


Figure 4. Length histogram of yellow perch collected by gillnets from East Lemmon Lake, Perkins County, 2001, 2003, 2006.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting lake surveys once every 2 years to evaluate fish populations and stocking success.

2. Continue annual fall night electrofishing to develop long-term trend data of largemouth bass due to frequent winterkill.

APPENDICES

Appendix A. Stocking record for East Lemmon Lake, Perkins County, 1991-2006.

Year	Number	Species	Size
1991	18,000	Largemouth bass	Fingerling
	18,000	Walleye	Fingerling
1993	18,000	Largemouth bass	Fingerling
	17,000	Walleye	Fingerling
1994	7,650	Largemouth bass	Fingerling
1997	18,900	Largemouth bass	Fingerling
1999	7,070	Largemouth bass	Fingerling
2000	18,000	Largemouth bass	Fingerling
2002	13,525	Largemouth bass	Fingerling
2004	500	Yellow perch	Adult
2005	884	Tiger muskie	Fingerling
2006	500	Tiger muskie	Fingerling

SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-39

Name: Shadehill Reservoir County: Perkins
Legal description: T 21N, R 15E Sec. 1,2,3,4,8,9,10,15,16,17,20,21,22,23,26,27,34,35,
Location from nearest town: 12 miles south of Lemmon, SD
Dates of present survey: August 3, 7-9, 2006
Date last surveyed: July 27; August 8-10, 2005
Most recent lake management plan: F21-R-36 Date: 2004
Management classification: Warmwater permanent
Contour mapped: July 1985

Primary Species: (game and forage)	Secondary and other species:
1. Walleye	1. Northern pike
2. Smallmouth bass	2. Bluegill
3. Channel catfish	3. White bass
4. Black crappie	4. Spottail shiner
5. Yellow perch	5. Common Carp
6. Emerald shiner	6. River carpsucker
7. Gizzard shad	7. Northern redhorse
8.	8. White sucker

PHYSICAL CHARACTERISTICS

Surface Area: 4,693 acres; Watershed: 2,176,000 acres
Maximum depth: 62 feet; Mean depth: 21.8 feet
Lake elevation at survey (from known benchmark): unknown

1. Describe ownership of lake and adjacent lakeshore property:

Shadehill Reservoir is, maintained and operated by the U.S. Bureau of Reclamation. South Dakota Department of Game, Fish and Parks maintains a recreation area/campground and game production area along much of the shoreline.

2. Describe watershed condition and percentages of land use:

The Shadehill Reservoir watershed is approximately 3,400 square miles, 75% of which is pasture and grassland, 20% agricultural cropland, and 5% forest and park land.

3. Describe aquatic vegetative condition:

Due in part to its contour and yearly water level fluctuations, Shadehill Reservoir has limited emergent and submergent vegetation. Good spring runoff produced large amounts of flooded

terrestrial vegetation in 2004, but low water levels in 2005 and 2006, has left very little vegetation in the rest of the lake.

4. Describe pollution problems:

Department personnel identified no pollution problems during the 2006 survey.

5. Describe condition of all structures, i.e. spillway, level regulators, boat ramps, etc.:

All access and regulatory structures are in excellent condition. There is a well kept state park that provides excellent facilities on Shadehill Reservoir.

CHEMICAL DATA

1. Describe general water quality characteristics.
Temperature remained a constant 21.6^{o}C throughout the water column and dissolved oxygen content was high (≥8 mg/l) down to 45 feet.

2. Thermocline: No

3. Stations for water chemistry located on attached lake map: Yes

BIOLOGICAL DATA

Methods

A lake survey was conducted on Shadehill Reservoir August 7-9, 2006. Sampling consisted of 8 gill net nights and 8 trap net nights (Appendix C). All gill nets were monofilament experimental 150 foot nets. The switch from 300 foot gill nets was to get better confidence in our catch rate data. The gill net was a monofilament experimental net 45.7 m (150-ft) long and 1.8 m (6-ft) deep with six 7.6 m (25-ft) panels of bar mesh sizes: 12.7 mm (0.5 in), 19.1 mm (0.75 in), 25.4 mm (1.0 in), 31.8 mm (1.25 in), 38.1 mm (1.5 in), and 50.8 mm (2.0 in). Trap nets were set at eight stations consisting of 1 trap net nights each. All trap nets were modified fyke-nets with a 1.3-X 1.5-m frame, 19.1-mm (¾-in) mesh and a 1.2- X 23-m (3.9- X 75.5-ft) lead. Collected fish were measured for total length (TL; mm) and weighed (g). In addition, scale samples for the first five fish per centimeter group were collected from selected fish per gear type for age and growth analysis. Scale samples were pressed onto acetate slides and viewed with a microfiche projector (40X) and the distance between scale annuli were recorded on paper strips. All data was entered into WinFin 2.95 (Francis 1999).

Fish population parameters, confidence intervals and standard errors were computed using WinFin Analysis (Francis 2000). Parameters calculated were catch-per-unit-effort (CPUE; number of fish collected per net night or number of fish collected per hour of electrofishing), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr) based on

length categories. Abundance was expressed as the mean catch-per-unit-effort (CPUE; mean number per net night). Population structural characteristics were expressed as length frequency histograms and stock density indices (PSD and RSD-P). Fish condition was expressed as mean Wr for stock length and larger fish.

Results and Discussion

Age-0 Fish Survey

Electrofishing

Ten sites around the lake were completed during daylight hours on August 3, 2006. All ten sites produced shad (Table 1). A total of 463 shad were captured in the .92 hours of electrofishing. This gave a CPUE of 505.0 young of year shad per hour. Last year, only twelve shad were sampled in two of the ten sites for a CPUE of 13.8 per hour. Total shocking time was 1.58 hours.

Table 1. Field form depicting daytime electrofishing results from Shadehill Reservoir, August 3, 2006.

Site	#/Site	Time(sec)	#/hr
South Arm #3	4	300	48
South Arm #4	53	300	636
South Arm #5	47	300	564
South Arm #6	49	300	588
Main #1	6	300	72
Main #2	138	300	1656
Upper #9	69	300	828
Upper #10	63	300	756
North Arm #7	32	600	192
North Arm #8	2	300	24
Total	**463**	**.92 hours**	**505**

Fish Community Survey

Gill and Trap Net Catch

Twelve species were collected in the four gill nets during the 2006 lake survey of Shadehill Reservoir, for a total of 518 fish. Channel catfish were the most abundant species comprising 38.4% of the total, while white bass were second most at 16.4% and gizzard shad were third with 16.2%. Walleye were the fourth most abundant species at 11.0%.

Eight trap nets sampled thirteen species for a total of 95 fish in 2006. White crappie comprised 22.1% of the total number with white bass being second most abundant with 15.7%. Bluegill was the third most abundant species, comprising 12.6% of the total catch.

Table 3. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses), and fish condition for fish larger than stock length (Wr>S; 90% CI's in parentheses) for all fish species collected from eight, 150-ft experimental sinking gill nets in Shadehill Reservoir, Perkins County, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	3	0.4 (0.4)	0.4 (0.4)	100 (--)	100 (--)	86.2 (18.7)
Channel catfish	199	24.9 (6.6)	22.4 (6.0)	36 (6)	0 (--)	78.9(0.7)
Common carp	5	0.6 (0.5)	0.6 (0.5)	60 (52)	20 (43)	92.0 (2.7)
Freshwater drum	21	2.6 (1.6)	2.1 (1.3)	24 (19)	0 (--)	102.2 (1.8)
Gizzard shad	84	10.5 (12.6)	0.8 (1.1)	50 (45)	0 (--)	105.8 (5.1)
Goldeye	1	0.1 (0.2)	--	--	--	--
Northern pike	4	0.5 (0.5)	0.5 (0.5)	25 (59)	0 (--)	78.3 (14.3)
River carpsucker	22	2.8 (0.8)	2.8 (0.8)	95 (7)	91 (11)	90.5 (1.9)
Shorthead redhorse	22	2.8 (3.3)	2.8 (3.3)	82 (15)	77 (16)	96.0 (1.8)
Walleye	57	7.1 (1.8)	6.1 (1.7)	27 (10)	4 (5)	84.0 (1.0)
White bass	85	10.6 (5.8)	10.6 (5.8)	99 (2)	9 (6)	84.3 (0.2)
White crappie	11	1.4 (0.9)	1.4 (0.9)	36 (28)	27 (26)	98.7 (1.0)
Yellow perch	4	0.5 (0.4)	0.5 (0.4)	75 (59)	0 (--)	83.6 (6.6)
Totals	518					

Table 4. Total catch (N), catch per net night (CPUE; 80% CI's in parentheses), catch per net night of stock-length fish (CPUE-S; 80%CI's), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for all fish species collected from 8 modified-fyke trap nets in Shadehill Reservoir, Perkins County, 2006.

Species	N	CPUE	CPUE-S	PSD	RSD-P	Wr>S
Black crappie	11	1.4 (0.7)	0.8 (0.5)	83 (33)	67 (43)	91.8 (3.1)
Bluegill	12	1.5 (0.9)	1.5 (0.9)	42 (26)	8 (15)	106.8 (5.8)
Channel catfish	3	0.4 (0.3)	--	--	--	--
Common carp	2	0.3 (0.2)	0.3 (0.2)	100 (--)	100 (--)	89.1 (23.6)
Freshwater drum	9	1.1 (0.7)	0.5 (0.5)	--	--	102.2 (7.3)
Northern pike	11	1.4 (0.6)	1.4 (0.6)	91 (17)	64 (28)	89.6 (3.2)
River carpsucker	3	0.4 (0.4)	0.4 (0.4)	67 (--)	67 (--)	87.2 (5.9)
Smallmouth bass	4	0.5 (0.5)	0.4 (0.4)	33 (--)	--	92.7 (10.4)
Walleye	2	0.3 (0.2)	0.3 (0.2)	50 (--)	50 (--)	83.5 (16.3)
White bass	15	1.9 (1.1)	1.9 (1.1)	60 (23)	0 (--)	85.4 (2.7)
White crappie	21	2.6 (1.4)	2.5 (1.4)	35 (19)	15 (14)	93.8 (1.1)
Yellow perch	2	0.3 (0.4)	0.3 (0.4)	100 (--)	50 (--)	83.0 (--)
Totals	95					

Black crappies

Black crappie density remains low with a 1.4 trap net CPUE (Table 5). Stock indices increased to a PSD of 83 and an RSD-P of 67, compared to 26 and 5 last year, respectively. Crappie condition was lower than last year with a mean Wr for stock-length and larger fish of 91.8. These numbers should be taken with a grain of salt as the black crappie sample only had 11 fish.

Table 5. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for black crappie collected by trap nets in Shadehill Reservoir, 2000-2006.

Year	N	CPUE	PSD	RSD-P	Wr > Stock
2000	16	1.3 (0.8)	69 (21)	50 (23)	101.6 (8.7)
2001	16	1.5 (0.6)	47 (23)	20 (19)	98.8 (6.2)
2002	42	5.3 (2.8)	10 (8)	0 (na)	99.1 (0.5)
2003	57	9.5 (3.3)	51 (11)	2 (3)	101.8 (1.4)
2004	45	5.6 (4.9)	96 (6)	7 (6)	101.3 (0.9)
2005	19	2.4 (1.9)	26 (18)	5 (9)	99.5 (2.6)
2006	11	1.4 (0.7)	83 (33)	67 (43)	91.8 (3.1)

Channel Catfish

Channel catfish continue to be the most abundant species sampled in gill nets with a CPUE of 24.9. Last year's CPUE was 32.3, but that was with 300 foot gill nets, so if you doubled this year's catch there could be an increase in abundance. PSD was 36 with not a single fish over preferred-length (Table 7). It's puzzling how none of these abundant catfish ever reach larger sizes. Possibly, our gear does not sample the larger fish. Past data shows very few catfish reach preferred-length. Condition was low with a mean Wr for stock-length and larger fish of 78.9. This steady population seems to change very little year after year.

Table 7. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for channel catfish collected by gillnets in Shadehill Reservoir, 2001-2006.

Year	N	CPUE	PSD	RSD-P	Wr >Stock
2001	97	19.4 (11.3)	36 (9)	0 (--)	96.5 (0.8)
2002	117	29.3 (17.3)	56 (0)	0 (--)	84.0 (0.6)
2003	139	34.8 (14.9)	48 (9)	0 (--)	90.6 (0.9)
2004	105	26.3 (7.5)	71 (9)	0 (--)	88.8 (0.6)
2005	129	32.3 (7.7)	58 (9)	0 (--)	82.7 (0.7)
2006*	199	24.9 (6.6)	36 (6)	0 (--)	78.9 (0.7)

*150 foot gill net compared to 300 foot nets in previous years

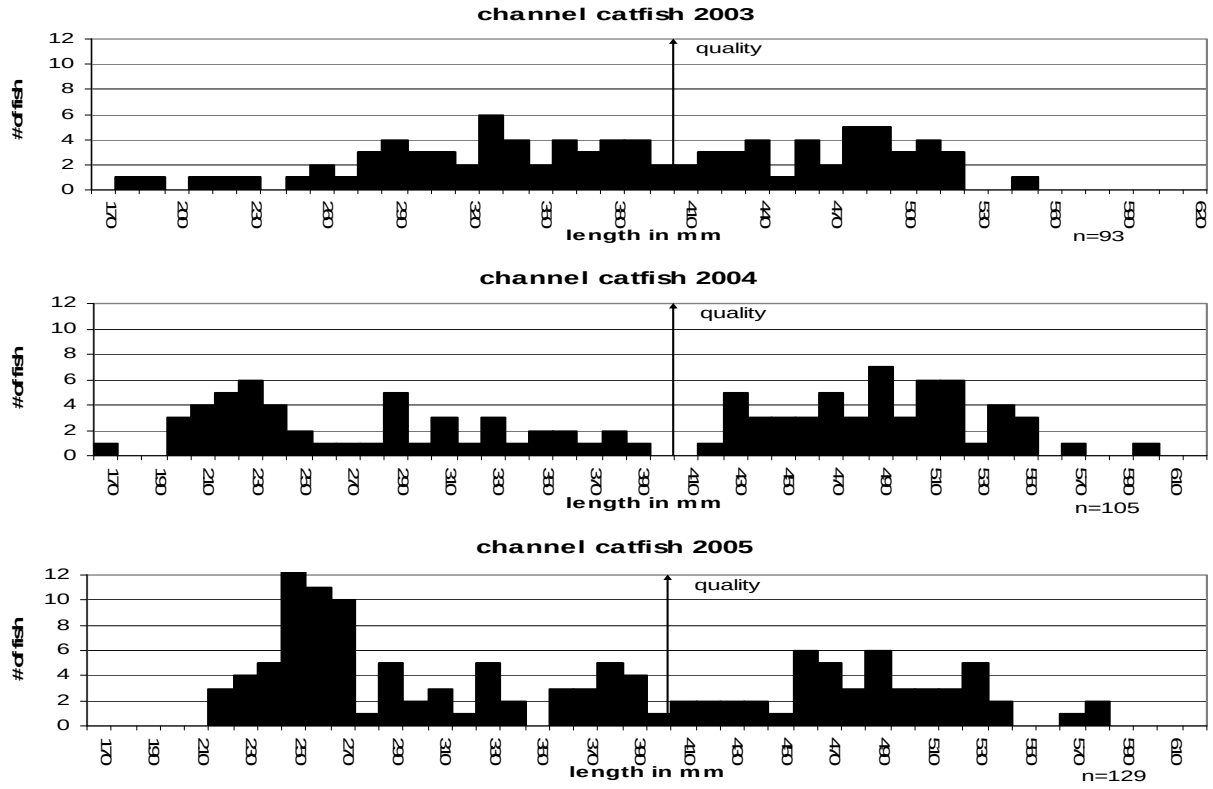


Figure 2. Length frequency for channel catfish from gillnets at Shadehill Reservoir 2003-2006.

Gizzard Shad

Gizzard shad were the third most abundant species caught in the 8 gillnets. The length frequency histogram shows most fish were young of year (Figure 3). It also shows a few age ones in the 250 mm to 290 mm that survived the winter. As stated earlier in the young of year survey, age zero shad numbers appear to be up from last year.

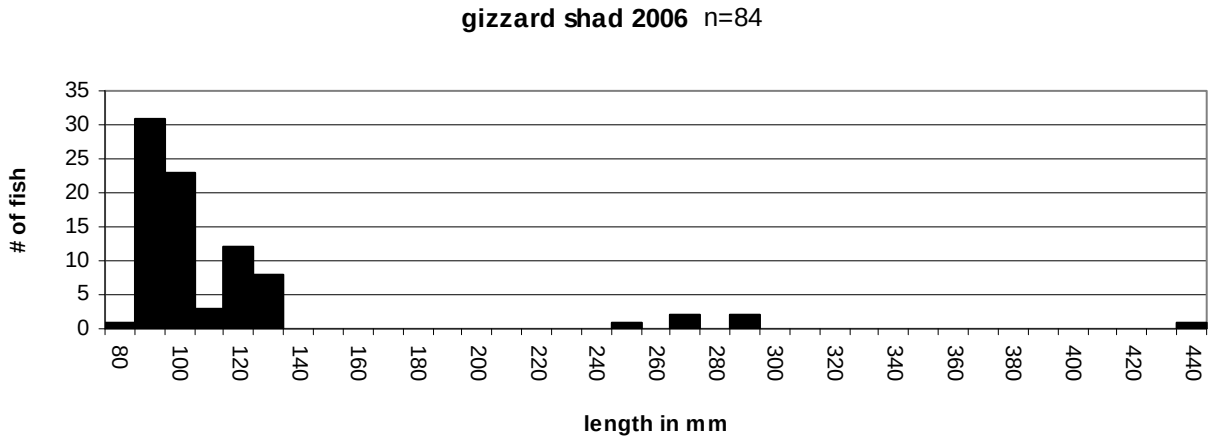


Figure 3. Length frequency histograms for gizzard shad from gillnets at Shadehill in 2006.

Walleye

Our walleye sample showed similar abundance to last year's sample. Gill net CPUE was 7.1, compared to 18.8 last year when 300 foot gill nets were used (Table 8). If you doubled this year's catch, it would fall within last's years gillnet numbers with the confidence intervals. Catch for stock length and larger fish followed the same trend. PSD for this sample was 27, which is up from 4 last year. Fish, over 20 inches, increased from a RSD-P of 0 to 4 this year. Length frequency histogram shows a little more "balanced" population compared to last year (Figure 4). A one fish over twenty inches regulation was added in 2003, hopefully protecting some of the larger fish and helping improve size structure. Growth was slower than the state and regional averages (Table 9). Fish condition was average with stock length and larger fish having a mean Wr of 84.0, slightly higher than last year's mean of 82.5.

Current walleye management objectives for the Shadehill walleye fishery is to maintain a minimum gillnet CPUE of 10 with a PSD of 30-60, and increase RSD-P to 10 or greater, and increase growth rates to near or at the regional mean. At this point, we are short on all aspects of the objectives, but we are also close to meeting all these objectives. Hopefully some additional stocking, and increase in the shad population will push us into our objective ranges.

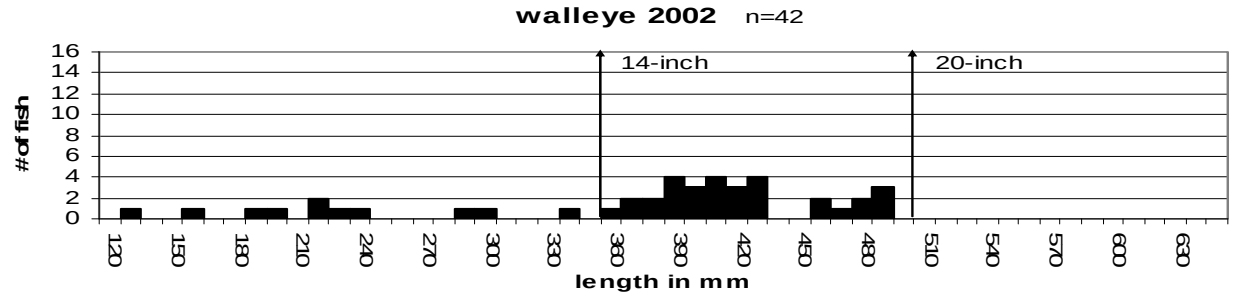
Table 8. Catch data for walleye collected by gill net in Shadehill Reservoir, 2000-2005.

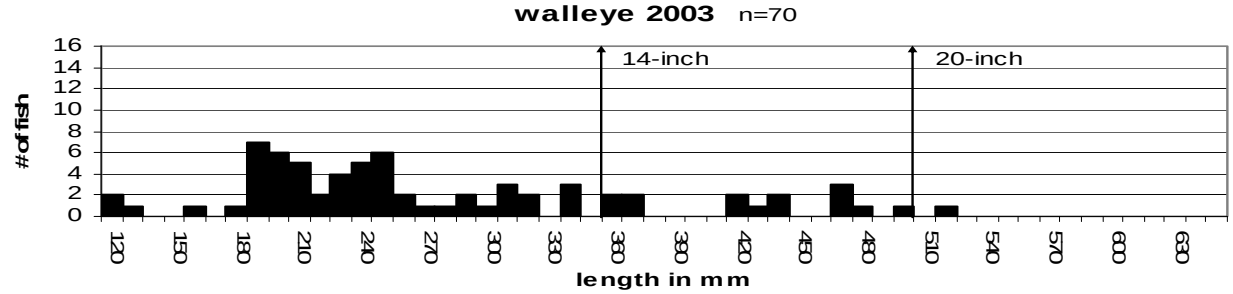
Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr >Stock
2000	122	20.3 (6.9)	20.3 (6.9)	9 (4)	2 (2)	81.2 (0.2)
2001	93	18.6 (10.1)	17.4 (10.2)	31 (8)	0 (--)	81.9 (1.1)
2002	42	10.5 (5.1)	8.5 (3.4)	82 (12)	0 (--)	83.2 (1.1)
2003	70	17.5 (7.2)	9.0 (5.7)	31 (14)	3 (4)	84.6 (1.2)
2004	42	10.5 (2.7)	9.5 (2.2)	32 (13)	5 (6)	84.6 (1.0)
2005	75	18.8(10.1)	17.3(9.8)	4 (4)	0(--)	82.5 (0.3)
2006*	57	7.1(1.8)	6.1(1.7)	27(10)	4(5)	84.0(1.0)

*150 foot gill net compared to 300 foot nets in previous years

Table 9. Shadehill Reservoir walleye year class, age in 2006, sample size (N), mean back-calculated total length at age, population standard error (SE), the Region 1 and South Dakota walleye mean length at ages (Willis et al. 2001).

Year Class	Age	N	1	2	3	4	5
2003	1	10	215				
2002	2	12	156	265			
2001	3	13	166	255	316		
2000	4	9	145	235	302	352	
1998	5	5	127	177	256	331	392
Mean (SE)			**162(15)**	**233(20)**	**291(18)**	**342(10)**	**392(0)**
Region 1			164 (17)	260 (22)	332 (27)	385 (32)	444 (42)
South Dakota			168 (3)	279 (6)	360 (7)	425 (8)	490 (9)


walleye 2002 n=42
14-inch
20-inch
#of fish
length in mm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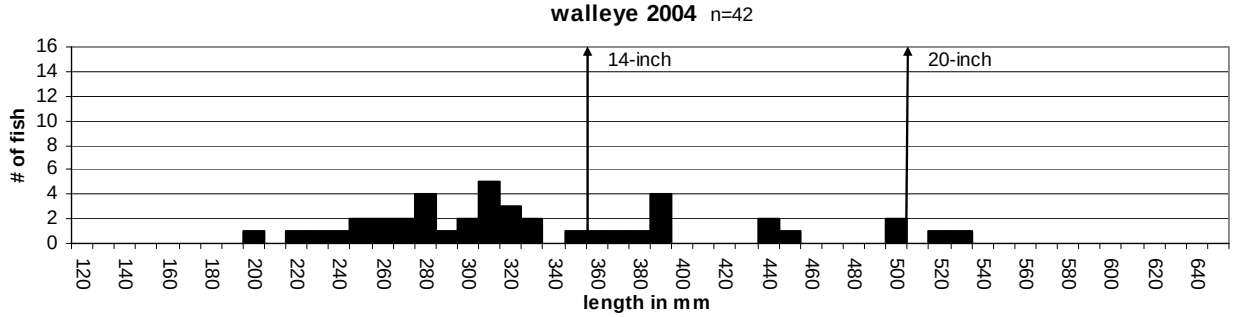
20-inch
#of fish
length in mm


walleye 2004 n=42
14-inch
20-inch
# of fish
length in mm

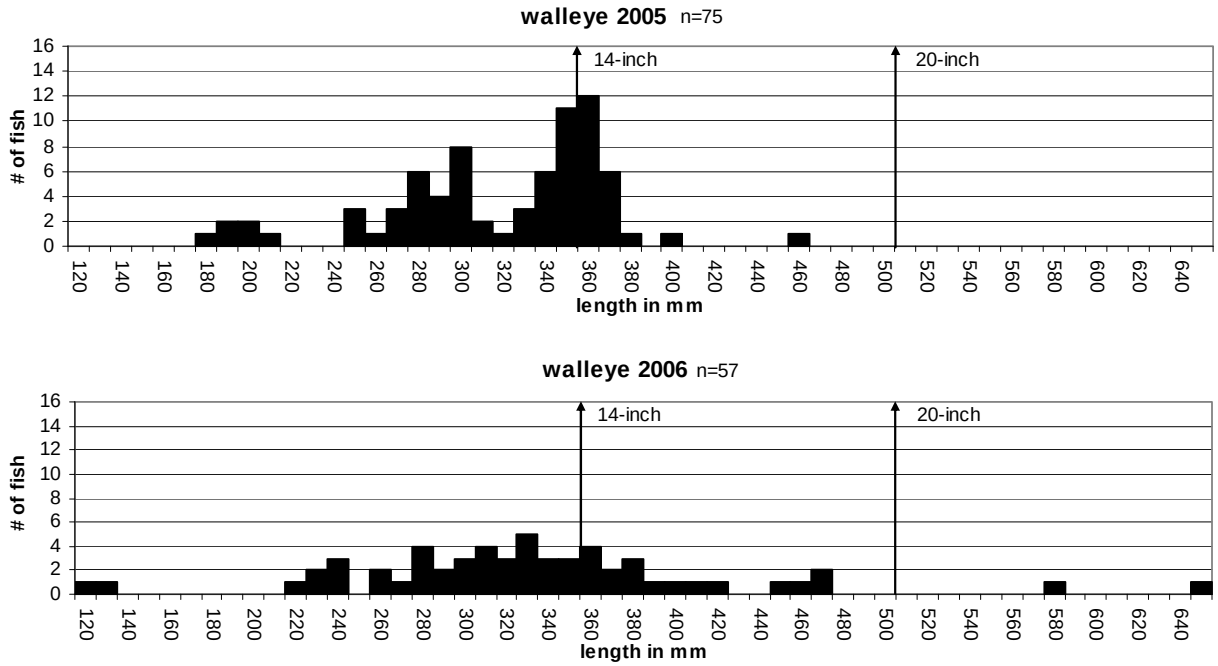


Figure 4. Length frequency histograms for walleye from gillnets at Shadehill from 2002-2006

White Bass

White bass abundance has decreased since last year when gill net CPUE was 60.5 for stock length and larger fish (Table 10). This year's gill net CPUE was 10.6 using one hundred-fifty foot gillnets. Doubling CPUE still gives a 65% decrease over last year. Stock indices were similar with a PSD was 99 with an RSD-P of 9. Last year PSD was 100 with an RSD-P of 2. Fish condition was average with a Wr for stock length and larger fish of 84.3. Most fish are from the 2001 year class. Length frequency shows that the fish seem to growing about 10 to 20 milimeters per year (Figure 5).

Table 10. Composite listing of sample size (N), catch-per-unit-effort (CPUE; 80% confidence intervals are given in parentheses), mean total length (TL; standard error is given in parentheses), proportional stock densities (PSD, RSD; 90% CI's in parentheses) and fish condition for fish larger than stock-length (Wr>S; 90% CI's in parentheses) for white bass collected by gill net in Shadehill Reservoir, 1999-2006.

Year	N	CPUE	CPUE-S	PSD	RSD-P	Wr > Stock
1999	13	1.4 (0.9)	0.9 (0.9)	100 (--)	25 (31)	77.7 (0.6)
2000	44	7.3 (7.0)	7.3 (7.0)	98 (4)	23 (11)	83.0 (0.8)
2001	93	18.6 (22.9)	4.6 (4.4)	91 (10)	74 (16)	88.0 (2.0)
2002	51	12.8 (8.9)	12.8 (8.9)	63 (12)	35 (12)	85.6 (1.1)
2003	293	73.3 (72.9)	73.3 (72.9)	91 (3)	1 (1)	87.6 (0.6)
2004	176	44.0 (45.0)	44.0 (45.0)	100 (-)	7 (4)	90.0 (1.9)
2005	242	60.5 (42.6)	60.5 (42.6)	100(--)	2(2)	85.5(0.0)
2006*	85	10.6(5.8)	10.6(5.8)	99(2)	9(6)	84.3(0.2)

*150 foot gill net compared to 300 foot nets in previous years

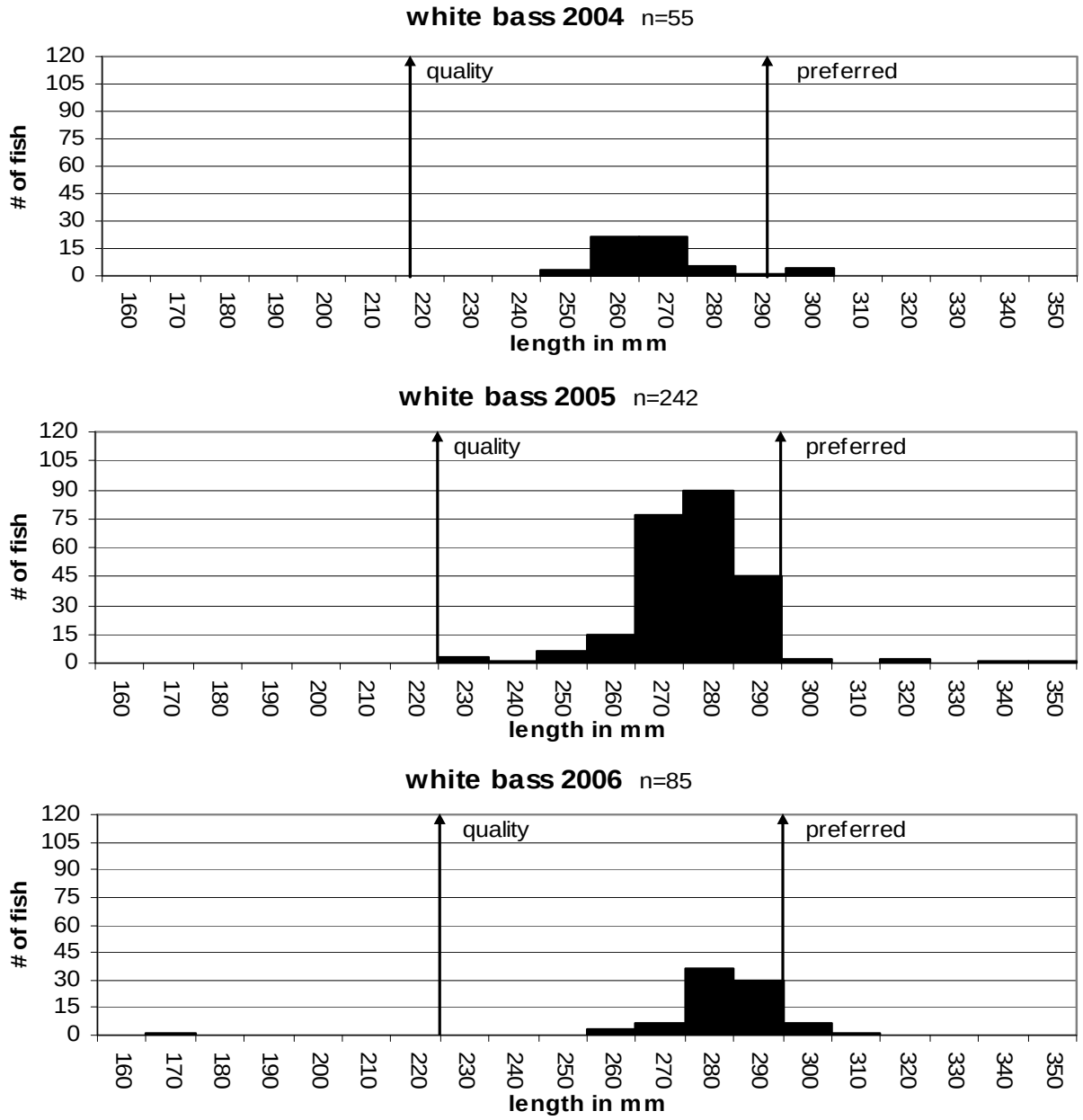


Figure 5. Length frequency histograms of white bass collected by gillnet in Shadehill Reservoir from 2002-2006.

White Crappie

White crappie numbers appear to be on the increase. Two years ago gillnets captured nine, last year gillnets caught 19. This year gillnets caught 21 and the frame nets had eleven. Fish condition was good with stock length and larger fish averaging a Wr of 93.8. Hopefully, these numbers will continue to increase in the future, to levels that will provide a good fishery as well as an additional forage base.

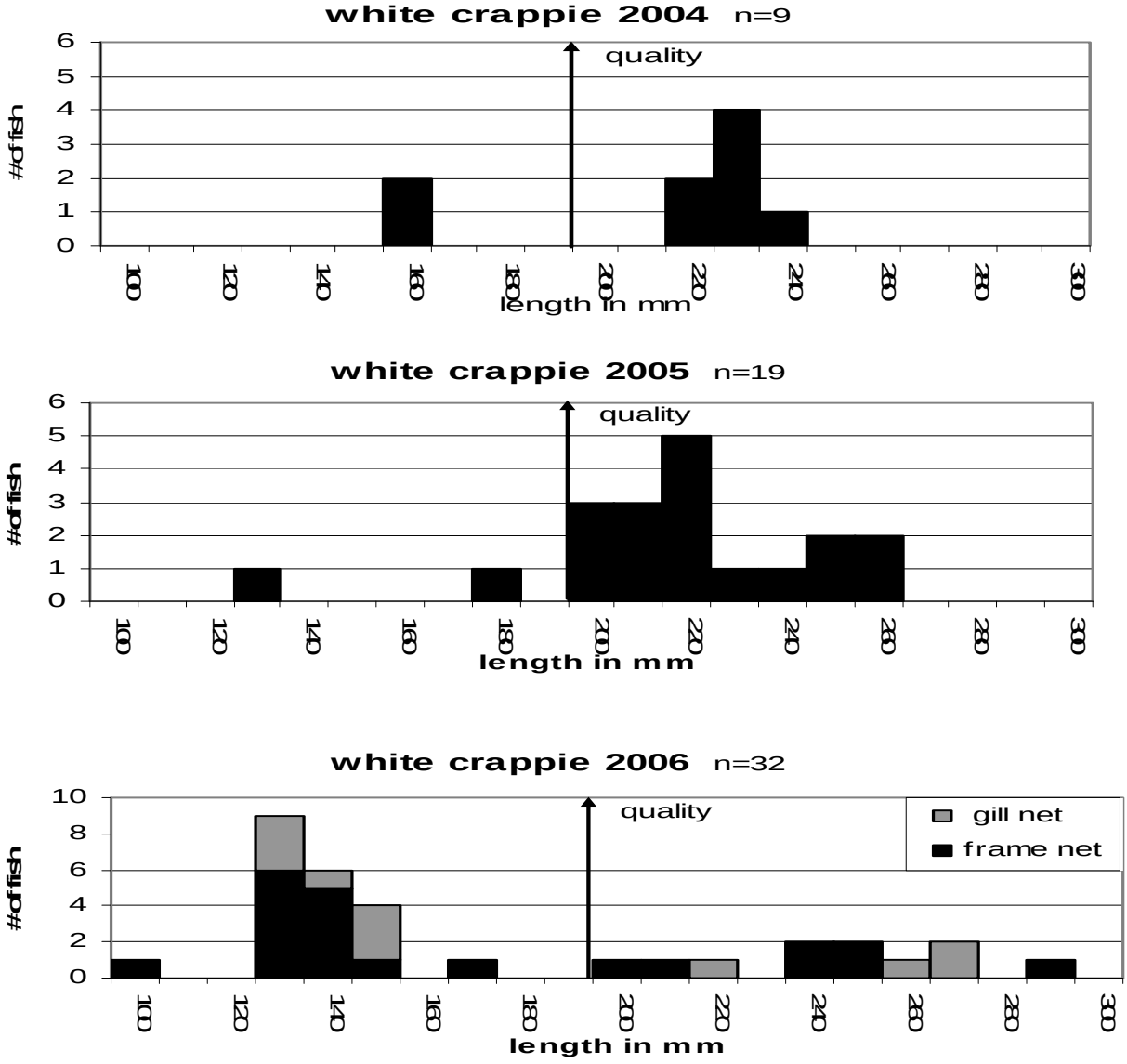


Figure 6. White crappie length frequency histogram in Shadehill Reservoir 2004-2006.

Other fish species

Nine other fish species were collected during the annual lake survey; bluegill, common carp, freshwater drum, goldeye, northern pike, river carpsucker, shorthead redhorse, and yellow perch. Other species listed had low catch rates (Tables 3 and 4). According to past surveys, this is normally the case with these species.

LITERATURE CITED

Francis, J. 1999. Winfin, Version 2.95; Microsoft Access Program for data entry. Nebraska Game and Parks Commission, Lincoln.

Francis, J. 2000. WinFin Analysis Program. Version 1.5. Nebraska Game and Parks Commission, Lincoln.

Willis, D.W., D.A. Isermann, M.J. Hubers, B.A. Johnson, W.H. Miller, T.R. St. Sauver, J.S. Sorenson, E.G. Unkenholz, and G.A. Wickstrom. 2001. Growth of South Dakota Fishes: A Statewide Summary with means by region and Water Type. Special Report. South Dakota Department of Game, Fish and Parks. Pierre, South Dakota.

RECOMMENDATIONS

1. Continue conducting a lake survey every year to evaluate fish populations and stocking success (i.e. gizzard shad introductions, walleye, and smallmouth bass).

2. Continue stocking adult gizzard shad annually to ensure adequate forage for the walleye and other predatory fish.

3. Stock small walleye fingerlings at 1 pound per acre to try to increase walleye density.

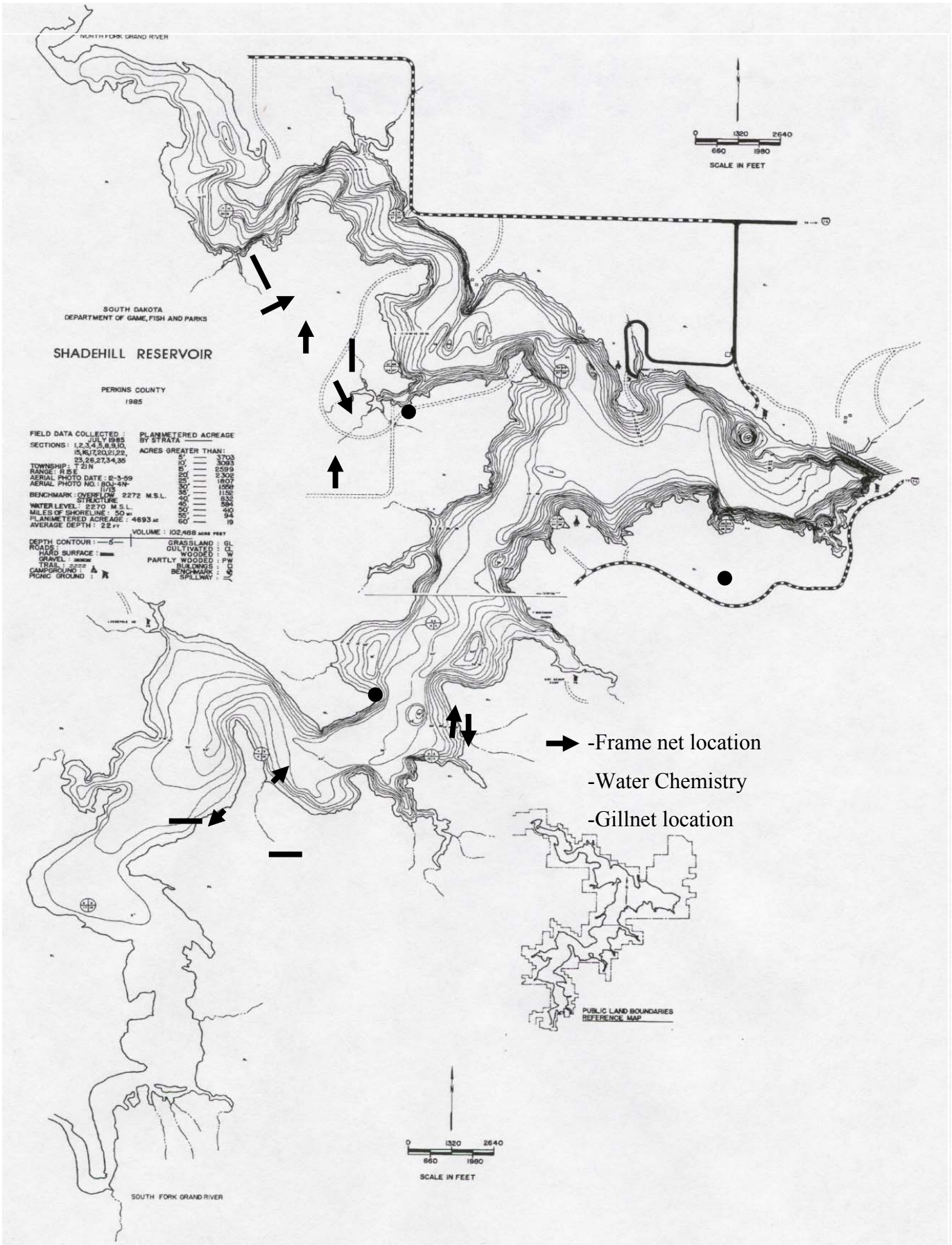
APPENDICES

Appendix A. Stocking record for Shadehill Reservoir, Perkins County, 1995-2006.

Year	Number	Species	Size
1995	25,000	Rainbow trout	Fingerling
1996	25,000	Rainbow trout	Fingerling
	50,550	Smallmouth bass	Fingerling
	393,000	Walleye	Fingerling
1997	24,053	Rainbow trout	Fingerling
	57,300	Smallmouth bass	Fingerling
	194,772	Walleye	Fingerling
1998	51,666	Smallmouth bass	Fingerling
	400	Yellow perch	Adult
1999	96	Gizzard shad	Adult
	50,000	Smallmouth bass	Fingerling
	150,918	Walleye	Fingerling
	6,750	Yellow perch	Adult
2000	251	Gizzard shad	Adult
	30,590	Smallmouth bass	Fingerling
2001	57	Gizzard shad	Adult
	138,075	Walleye	Fingerlings
2002	50,000	Walleye	Fingerlings
2003	251	Gizzard shad	Adult
2004	233	Gizzard shad	Adult
	162,700	Walleye	Fingerlings
2005	250	Gizzard shad	Adult
	200,300	Walleye	Fingerlings
2006	65	Gizzard shad	Adult
	166,698	Walleye	Fingerlings

Appendix B. Water chemistry results from on Shadehill Reservoir, August 30, 2006.

Site	Depth (ft)	Temp (^{o}C)	D.O. (mg/l)	pH
A	surface	21.6	9.1	8.9
	2.5	21.7	8.6	9.1
	5.8	21.7	8.4	9.1
	9.9	21.6	8.3	9.1
	13.7	21.6	8.3	9.1
	17.1	21.6	8.3	9.1
	21.8	21.6	8.2	9.1
	25.2	21.6	8.2	9.2
	29.8	21.6	8.1	9.2
	34.2	21.6	8.1	9.2
	38.8	21.6	8.1	9.2
	41.7	21.6	8.1	9.2
	45.5	21.6	8.0	9.2



Appendix C. Sampling locations on Shadehill Reservoir, 2006.